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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

GERMAN HIGH-SPEED EXPERIMENTS.

Although the result of the Zossen high-speed tests showed that the track was the weak part of the installation, it is stated that German engineers are now getting ready a steam locomotive for similar experiments on the same track. This would seem to involve a good deal of unnecessary trouble. The track was found unsuitable and did not even permit a thorough test of the electric locomotive. Instead of laying down a better track and continuing the work so well begun, they are building a special steam locomotive and will see what can be accomplished with this on a track known to be unsafe for speeds, but a little in excess of those now obtained on standard steam roads.

The results of these tests with steam can hardly be expected to repay the trouble and expense of making them, and we do not believe that the German engineers will be satisfied until the electric locomotive has been given a more thorough trial than has yet been done.

ELECTRIC AUTOMOBILES.

It is worthy of remark that although electricity is rapidly replacing other means of locomotion, the new industry of the automobile is comparatively little dependent upon it. Other types, however, are being developed and exploited with considerable success.

We do not believe that this is a healthy condition. Electric propulsion has some disadvantages as has any other system, but it also has some very decided advantages. The greatest drawback to the electric automobile at present is, of course, the question of a suitable battery. The prevailing impression is that the accumulators are heavy, depreciation is excessive and that the range of travel is restricted, owing to the necessity of recharging batteries. A trip must be so planned that a charging station is reached before the batteries are exhausted.

All these defects are true to some extent, but if a careful comparison of the electric and other types were made, these defects would probably be found to be exaggerated. Then, on the other hand, the advantages of electric driving are not small. The mechanism is simple, clean and reliable, control is easy, and it is comparatively quiet and free from objectionable odors. It is strange under these conditions that more has not been done with electric automobiles.

One attempted solution of the problem has been to equip the carriage with driving motors operated from a storage battery which, in turn, is charged from a petrol generating set. This seems at first sight to be only making matters worse by supplying two complete systems, but on closer inspection the case is not so bad. The battery equipment can be comparatively small, as can also the engine and generator. Ordinarily, the motor capacity of other types must be sufficient for the maximum demands. This necessitates a larger and heavier equipment than is needed for all ordinary uses. In the combination above described, however, the generator and battery need be only large enough for the average power. The motors, of course, would have to be able to take care of the greatest demand, but electric motors are capable of standing considerable overloads for a short time, and they could be kept comparatively small. At these times of overload the dynamo and battery could be operated in parallel, each to its full output.

From these considerations we see that the total weight of machinery for such equipments need not be increased very greatly over that of the usual motor and battery set. This arrangement would give the electric automobile a freedom of movement as great as that of the petrol or other types without sacrificing any of the advantages of electric driving. Of course the added generating set would complicate matters somewhat, but this should be entirely automatic and not require any further attention after being started, leaving the operator with nothing to watch but his motors.

There can be little doubt as to the ultimate success of electric automobiles as soon as the battery question is solved. Now it would seem to be a wise move for the electric companies to take up the question of developing a suitable equipment, either along the lines indicated above, or simply an accumulator carriage, so that when an entirely satisfactory battery has been produced the rest of the equipment will have been fully developed.

A NEW YORK STATE ELECTRICAL LABORATORY.

At the last session of the New York State Legislature a commission was appointed to report upon the necessity for establishing an official electrical standardizing laboratory to which could be referred all questions of electrical science and practice requiring authoritative information.

The significance of this proposition fur-

nishes food for thought to even the best informed in the profession. What is there different in applied electricity from any other technical subject that should make it necessary to create a special branch of government to deal with problems arising therefrom?

Several reasons seem to make the establishment of such a bureau necessary. First, the widespread and ever increasing applications of electricity which makes the subject a matter of interest to the people as a whole, who can not hope to gain the technical information necessary to protect these interests themselves; second, the inherent difficulty and complexity of the subject, which gives ample foundation for differences of opinion even among experts themselves, as well as opportunity for numberless fakes and deceits. Further, the tremendous amount of capital involved in the commercial applications. In addition to that directly invested in the production and application of electrical machinery, changes from older methods to a newer and better one have interested other industries in electrical matters.

The real value of such an institution will depend largely upon the willingness of those to be benefited to accept its decisions. Of course, in the matter of units and standards there can be no question, but many instances will be suggested to engineers where the institution at the best can only act as a court of arbitration, and though one is forced to accept decisions where simple facts are concerned, one is always free to decide whether or not he will submit to arbitration. To illustrate this point, let us say that a certain municipality has contracted with an electric lighting company for lamps of a certain candle-power. Unless the city had employed a competent engineer to assist in drawing up the contract the specification in regard to the lamps is doubtless vague, and a dispute may easily arise between the city and the lighting company as to whether the latter is living up to its contract. Who can decide this? There is no legal standard of light, nor a standard method of rating lamps. The question of correct rating of electric meters is an important one, which at present is left entirely to the supply companies. This can hardly be considered as a satisfactory arrangement from the consumers' viewpoint. And many other cases could be cited where the opinion of a competent and authoritative body would be accepted as final.

In order to gain the necessary confidence for the successful working of this bureau, it is absolutely essential that its work shall be of the highest standard. Not only must all possible means be at its disposal to get at facts, but there must be those at hand capable of interpreting the facts. The laboratories must be the best equipped possible, and the force chosen from the very head of the profession. Nor must there be any barriers in the way to prevent people from obtaining the full benefit of the results. It must be entirely outside of politics or any outside influence.

If this condition of affairs can be confidently expected, so far as its moral aspects are concerned, there yet remains the consideration of the tremendous task of organizing and keeping up the work of such an institution for such a purpose. The growth of the science is such that no sooner is one set of facts neatly assorted and labeled than a new set shows the old in an entirely different aspect. But what order we can get out of the present condition by all means let us have! It is not a question of whether there is work and need for such an institution, but whether it will be able to cope with the work there is. The next generation or the next ten years will not find the matter any easier. The feeling of a great many of those who are most competent to determine just such matters as the bureau will take up will doubtless be one of entire willingness to pass on the responsibility to an authorized and official body, and that as soon as possible.

PLATINUM.

The fact that the production of platinum is not increasing as rapidly as is its consumption is causing considerable concern in many lines of work. Unless new sources of supply are discovered, and this does not seem probable, or a satisfactory substitute is found, certain branches of the electrical industry will be unable to secure the requisite quantities for their work and will be seriously handicapped.

Nearly all the platinum mined to-day comes from Russia. While this metal is found in small quantities in the United States, it has not been found to pay for extracting it. The deposits in New South Wales promise better, and it is to be hoped that mining will soon be begun there on a suitable scale.

In the meantime, it might pay if some of our inventors would turn their attention to finding a suitable substitute for this costly metal. A careful study of alloys might result in a valuable discovery.

RELIABILITY TEST OF AUTOMOBILES.

The rules and regulations of a five-hundred-mile reliability test to be conducted by the Automobile Club of America have been published. The route selected is from New York to Boston and return. These rules are full and explicit and provide for all probable contingencies. Classification of vehicles is by weight alone and irrespective of the kind of motive power.

As the test is for reliability only, high speeds are especially prohibited. The marking is to be based upon an average speed of fifteen miles per hour or four minutes to the mile, each mile crediting four marks. Thus the run from New York to New Haven is seventy-nine miles and counts three hundred and sixteen minutes or marks if the run is clear. One mark will be deducted for each minute the vehicle is at rest, except for certain involuntary stops, as provided for. Average speeds of over fifteen miles per hour will not be recognized.

These rules are eminently sensible, and the results of the test will be not only interesting but valuable as affording a satisfactory test of the various makes of machines. This test will certainly prove of more utility to automobilists than any high-speed, record-breaking run in which so much depends upon chance.

The contest committee is to be congratulated that it has decided upon so sensible a method of conducting a test.

THE ELECTROLYSIS OF GAS MAINS.

BY JAMES SWINBURNE.

(*Concluded from page 264.*)

We may now consider what the gas and water companies can do to protect their pipes. Throughout the danger area they should be metallically connected with the power-house or the suckers. Coating with Angus Smith's composition, or asphalt, tar and the like, is proved to give little or no protection. It is found that wrought-iron pipes are corroded more quickly than cast, especially close-grained cast-iron. In this country wrought iron is only used for service pipes as far as I know. It would be an advantage to destroy the electrical continuity of pipes by occasionally packing joints with sulphur, sulphide of iron, or something other than lead. Lead does not make a good electrical joint. Pouring lead round does not remove the bituminous coating of the pipes. Lead also soon coats itself with insulating compounds, such as hydrated oxide, which prevents its making good electrical contact. This should be done especially in places where the ground happens to be dry and well drained. It has been proposed to adopt earthenware or stoneware pipes. Such schemes are of little value. The pipes are already down, and, generally speaking, will remain down unless something serious happens to them.

The insulation of occasional joints in water pipes would also be of advantage. It might be supposed that this would do little, because the water conducts, and would therefore make a passage round the insulated joint. The water supplied to houses is, however, such a very poor conductor that the current carried by it may be neglected. Insulating the joints in this way may, however, sometimes do harm. For instance, suppose a line of pipe is carrying a current which is taken to the power-house by a metallic wire connected to it for the purpose, the pipe might have no current leaving it, and therefore no corrosion. If the pipe is insulated at a joint it will introduce a local resistance; and the electricity will leave the pipe and go into the earth close to the joint, entering the pipe again a little further on. One side of the joint thus becomes anode with corrosion, while the other becomes cathode, which does not matter. Insulating joints does not, therefore, necessarily help. It reduces the current, but at the expense of local corrosion, unless the joint is in very dry ground. If joints are insulated at very frequent intervals the pipe will be so discontinuous as a conductor that it will pick up no appreciable current. Insulation of joints is therefore a good measure when taken judiciously, but it is not always possible, as a company can not well open up the roads on purpose to break the joints and recaulk the mains.

Practically the only thing the pipe-owning companies can do to safeguard themselves, or to lessen the effects of stray currents, is to insert insulating joints at intervals where possible, and to connect the pipes metallically with the power-house, or the rails in danger areas —that is to say, in areas where the pipes are apt to be anodes.

Cast-iron pipes are sometimes joined up with wrought-iron or lead service pipes, often with brass couplings. Such metals in damp soil set up local currents of their own, which eat the lead or wrought iron apart altogether from any tramways.

The next, and perhaps the most important question, is: How much damage are electrical tramway systems doing now, and how much will they do in the future? We hear a great deal about the damage done in the United States; and there is no doubt that there has been a great deal of trouble there. The statements in the technical press are exceedingly difficult to deal with. There is strong partisanship and great exaggeration. In addition, many of those dealing with the matter have very inaccurate notions about electrolysis.

The conditions in America are different, but especially they have been different. Damage by electrolysis is essentially a matter of time, and the corrosions that are now making themselves evident in America are the results of past working. Electrical tramways have been in extensive use there for some twelve years, and it might appear that the present state of the pipes shows us what to expect here in ten years or so. This, however, is not so. In America, especially in the early days of tramways, the rails were of small section, and they were very badly bonded. They were largely laid in mud, which forms the bed of many American roads. But, more than all this, they frequently allowed thirty volts in the rails or three times our permissible maximum.

But there is another point. Any stray electricity that gets into pipes must have left the rails, and must have corroded them proportionately. But the current in the pipes is only a fraction, generally a very small fraction, of the whole stray current; so that if there is corrosion of pipes there is very much greater corresponding corrosion of the tramway rails. In their own interests, therefore, electrical engineers keep the stray currents down as low as they possibly can. Of course, if a considerable part of the stray current goes along a pipe, and frequently leaves it to go round an insulated joint, returning to it after the joint, there is corrosion wherever it leaves the metal. If there are many such joints, the total corrosion of the pipes may be comparable with that of the rails, or even greater, though the current from the rails is greater than that in the pipes. But the frequency of such insulated joints in practice sends the resistance up, so that there is then comparatively little current in the pipe circuit.

The most remarkable fact about electrolytic corrosion is that it is clearly not so great as might be expected. It has even been said that the earth conducts like metals, non-electrolytically, so that electricity can leave rails or pipes and go into the earth without the corresponding corrosion. This theory is far too good to be true. The components of the soil are mostly insulators in themselves. Such substances as silica (sand), and the various silicates of which clays are composed, and chalk, are all insulators; and the conduction is due not to them, but to the salts dissolved in the water that moistens them. No transparent body can conduct otherwise than electrolytically. This theory appears to me, for one, quite untenable.

It is much more probable that, in estimating the corrosion of pipes, people are apt to overestimate the difference of electrical pressure between points in the earth. Take a simple case of a long straight single rail on the surface of comparatively badly conducting earth. Suppose that it is at two volts above the ground in pressure. The ground just in contact with the rail will be raised to two volts. The earth a long way from it, on the other hand, will be at zero pressure, if not disturbed by some other source of electrical pressure. There is thus a gradual fall of from two volts to zero as the distance from the rail increases. But the rate of decrease of pressure is much greater close to the rail than far off it—in fact, the rate at which the pressure will decrease is approximately inversely proportional to the distance. The result of this is that the pressure falls quickly as the distance from the rail increases. Another way of putting it is that the earth itself in the more immediate neighborhood of the rail acts as a sort of coating, the two volts being nearly all spent

on it. The pressure of the earth a short distance from the rail will thus be very little above zero.

If a good conductor, such as a pipe with electrically conducting joints, were laid in earth which was two volts above zero pressure, and if the pipe were kept at zero pressure by being connected to a power-house, or by going into a region where the earth was at (say) two volts, it would, if of equivalent size and shape, pick up a current equal to that leaked by the rail already discussed. But if it is laid in a region at a minute fraction of a volt above the normal, it will only pick up a corresponding current. One of the few papers which gives definite information in a useful form is by Larsen & Faber.* These observers measured the currents in pipes following the tracks, and found values which are serious. These observations go to show that pipes close to lines with large pressure drops will, if not protected by metallic connections, be seriously corroded in course of time.

It is probable, in spite of this special case, that pipes pick up much more minute currents than is generally believed. Another reason for supposing that the pipes do not take up very large currents is that there are earth currents due to natural causes. Now, earth currents would cause electrolysis just as much as stray tramway currents. But pipes have been in the ground for not very far off a century, and pipes fifty years old are often found to be as good as new. Yet the earth currents have been going on all the time. Unfortunately, we have few useful data about earth currents. What we want to know is the differences of electrical pressure between one region and another. The observations are made by the telegraph authorities, and they have nearly always given their results in terms of the current in their wires. They have given these without stating their resistances, so that their figures are useless.

Fortunately a few telegraphists, instead of reading the deflections of a galvanometer, have tried how many telegraph battery cells had to be put in to reverse the current, and from this we can get a rough idea of the differences of pressure between different regions. I may mention that Varley once found between London and Ipswich a difference of pressure of about 140 volts, or two and one-third volts fall of pressure per mile. Such pressures are variable; but they are comparable with the disturbances due to electrical tramways.

I have measured the currents in pipes where there are no tramways within many miles, and found them comparable with those found near working tramways. Yet they do not seem to do so very much harm. It is possible that all corrosion of pipes, apart altogether from tramways, is produced by, or accompanied by, electrolysis. Dissolved oxygen, or oxydizing solutions in the earth, would attack iron without electrolysis, but it is doubtful if the moisture in the earth contains such matters. The decaying vegetable matter and humus and in towns the decaying animal matter, would all be reducing agents, and prevent direct oxidation of iron.

Though what I have been saying may tend to allay fears as to the ravages of electrolysis, I certainly do not mean to say tramways will do pipes no harm. They certainly will do them no good. The question is: How much harm will they do? Electrolysis involves damage of the most insidious kind. It means a gradual corrosion of pipes until they either break or develop leaks in all sorts of unexpected places. Whether it will really damage the property of gas companies to a serious extent I, for one, can not say. It is a matter of time.

The best thing gas and water companies can do is to watch their pipes carefully, inspecting them whenever they are open for other purposes. When the road is opened and a pipe uncovered it would be as well to measure the electrical current in it. It is quite easy to measure the current in a pipe. The fall of pressure over a given length, excluding any joints, can be taken with a sensitive galvanometer. The resistance can be calculated, or else found by measuring a similar pipe. From these data the current is got. By including a joint, the resistance of the joint can be found. The measurements of current should be taken day and night, to see if the current is due to tramways.

Another measurement that is important is the relative pressure of the pipe and neighboring earth. If the pipe is positive to the neighboring earth, it is acting as an anode, and is therefore being corroded, and ought to be metallically connected with the power-house. If the pipe companies can not get legal protection, the best thing they can do is to make friends with the tramway people. Where the electrical tramways and the gas and water are owned by a local authority there ought to be no difficulty; but even otherwise the electrical company and the pipe owners would do well to work together. To make these electrical tests involves some electrical knowledge, and gas and water companies do not want to employ electricians on their staffs. The tramway people could generally make these tests for them without any great difficulty and arrange experiments with them.

The next question is as to whether pipe companies should have damages if their pipes are eaten. This seems obviously fair. But there is very serious difficulty in carrying such protection clauses into effect. A gas company finds its pipes eaten in one district. The first thing is to prove the corrosion is electrolytic, and not due to natural causes. This is in itself not necessarily easy. Suppose it is clear that the failure is due to electrolysis, the electrolysis may be due to natural earth currents. If not, and it is due to an electrical system, who is to say which system? In small towns where there is only one tramway system the chance of appreciable electrolysis is small. In large towns there are, or soon will be, several tramway systems, and probably some electrical railways. It would be very difficult for a London company to decide who ate its pipes, and still more difficult to bring the crime home by the clumsy and expensive method of arbitration.

To make the tramway people liable for any damages is obviously fair; the real difficulty is to carry the matter out. Such a liability is for that reason very serious to the tramway. A small tramway—which we will for this example suppose really innocent—is liable to be mulcted in damages that might ruin it, by a mistake of judgment of an arbitrator, or of experts called before him. This is a very serious liability.

To sum up, there is electrolysis, and your pipes are being eaten; but whether or not the corrosion is really serious can hardly be settled yet. Tramways are increasing in all directions, but they are also being more and more carefully designed. The large systems use lead-covered cables themselves, which are infinitely more easily damaged by electrolysis than gas pipes, because the lead is easily corroded, the conductors are continuous, and the cables are generally near the tram lines. The electrical tramways are thus more likely to damage themselves than their neighbors by any bad design or careless working. It behooves gas and water companies, however, to watch carefully. The question of electrolysis is not really settled. In the course of years we may have more information, and we may then find either that the stray currents are practically harmless, or that new laws have to be made.

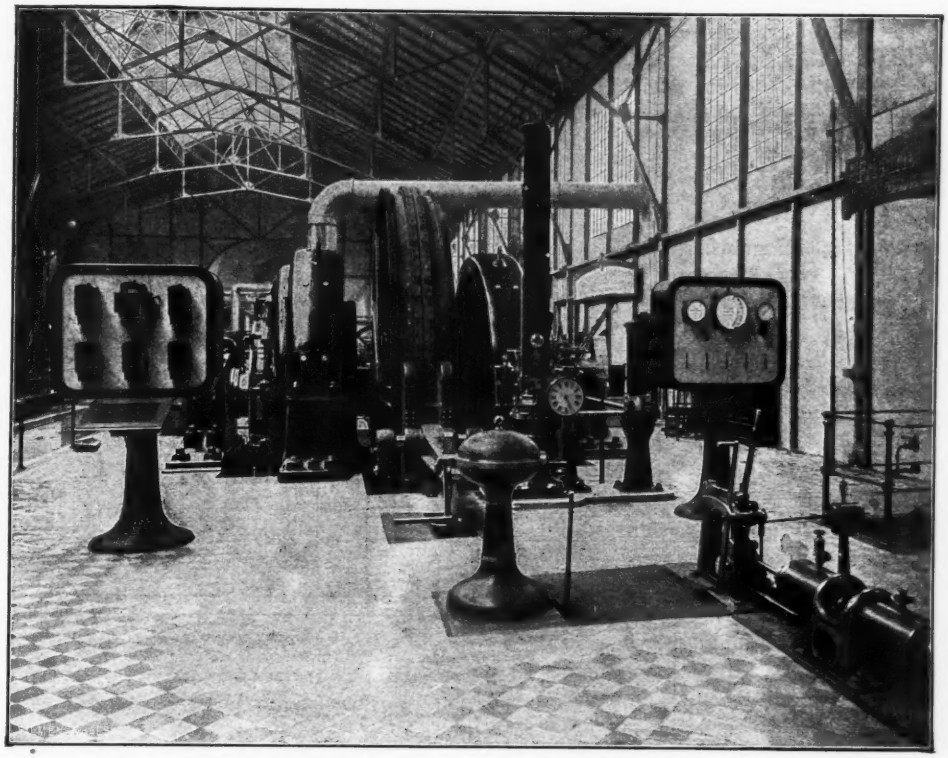
* *Elektrotechnische Zeitschrift*, 22, pp. 1038-1043. December 19, 1901.

AN ELECTRICALLY DRIVEN HOISTING MACHINE.

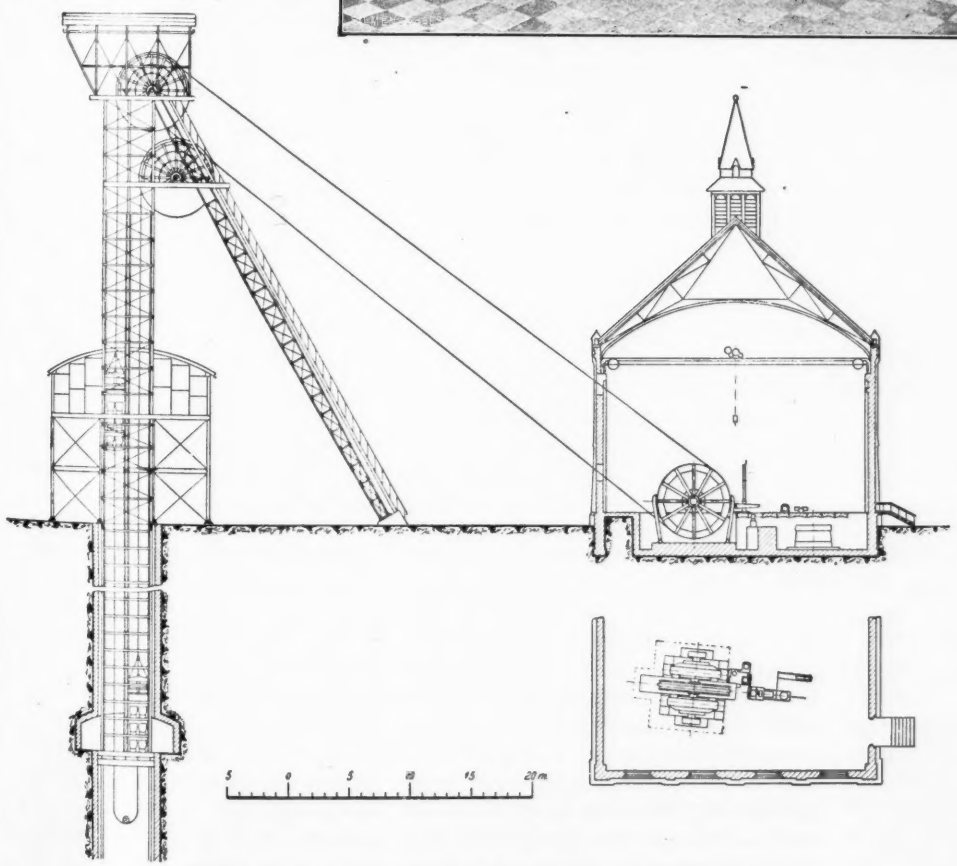
An electrically driven main shaft hoisting machine, constructed by the Aktiengesellschaft Bergwerksverein Friedrich Wilhelmshütte, in Mülheim, in cooperation with the Siemens & Halske Aktiengesellschaft, in Berlin, will be erected at the Zollern II pit of the Gelsenkirchener Bergwerks-Aktiengesellschaft.

This company operates all the machines of the new plant at the above-mentioned pit electrically, and decided in March, 1901, after a thorough study of the technical and economical questions involved in electric hoisting, to introduce electrically operated main hoisting machines.

The hoisting machine is designed to raise a load of 4,200 kilogrammes of coal, corresponding to six trucks of 700 kilogrammes each, in one lift from a depth of 500 metres, with a maximum speed of twenty metres per second. With sixteen effective hoisting hours per day and a depth of 500 metres, the daily capacity is 2,700 tons, with a single unloading platform. With a double platform the capacity increases to 3,200 tons, and with three platforms, to 4,000 tons. The Koepe system of driving-pulley is used, in which the hoisting rope passes but once around the pulley, and is driven by the friction of the oak lining, with which the groove is provided. The Koepe driving-pulley is most suitable in the case of hoisting from one level only, as the mechanical connection between the two cages, *viz.*, the rope, renders a change in the relative position impossible. It has, moreover, the advantage of requiring only a very small constructional width and small moving masses, giving in consequence a quicker acceleration. As by this system the hoisting rope is continued below the cages as tail rope, the total load is perfectly balanced and the working conditions of the motors are very favorable, especially during the acceleration.



GENERAL APPEARANCE OF HOISTING MACHINE.



GENERAL VIEW OF HOISTING PLANT, GELSENKIRCHEN, GERMANY.

The diameter of the Koepe pulley was fixed at six metres, which is as small as is consistent with the durability of the rope and the necessary small specific pressure between rope and pulley, because smaller electric motors can be used if the speed is increased.

Electric energy is transmitted to the motors as

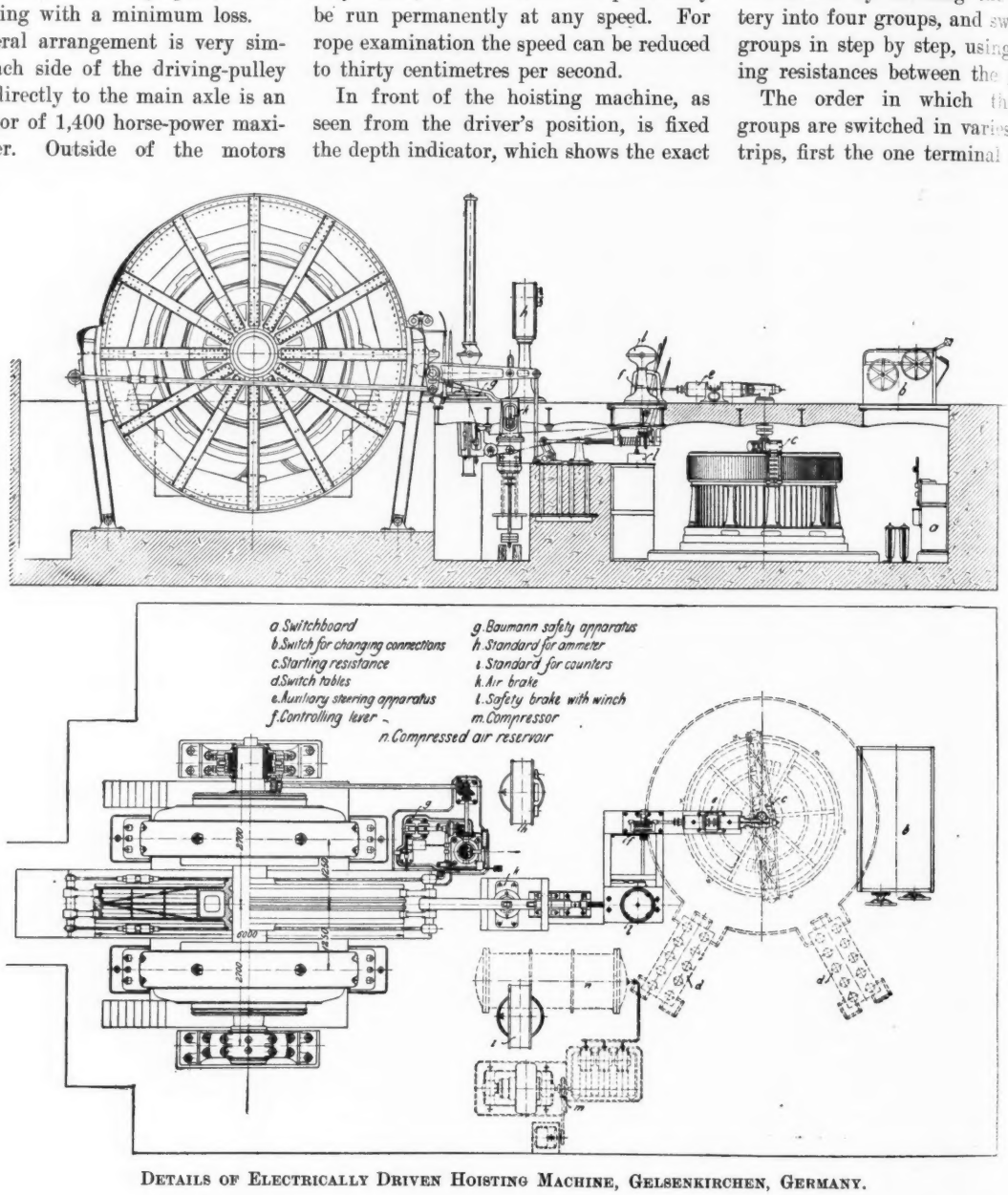
continuous current at 500 volts, because, in connection with a buffer storage battery, this gives a good storage of power for the very intermittent work, and, moreover, the gradual switching in of the voltage, with increasing speed, allows of accelerating with a minimum loss.

The general arrangement is very simple. On each side of the driving-pulley and keyed directly to the main axle is an electric motor of 1,400 horse-power maximum power. Outside of the motors powerful main bearings are arranged, having automatic ring lubrication. Instead of one single driving motor, a set of two was chosen, partly because by series or parallel control the maximum hoisting speed could be either ten or twenty metres per second, and partly because if one motor is stopped from one reason or another, the hoisting could be continued with reduced load, in order to bring the miners to bank, etc. By the gradual switching in of the storage battery, an alteration of the exciting current of the motor magnets, other speeds can be attained without energy losses, so that the attainable speeds are 2, 4, 5, 6, 8—10, 12, 16—20 metres per second. Since the losses by speeds intermediate to these are very small, the machine can practically be run permanently at any speed. For rope examination the speed can be reduced to thirty centimetres per second.

In front of the hoisting machine, as seen from the driver's position, is fixed the depth indicator, which shows the exact position of the cage in the shaft at any time and is directly connected with a Baumann's safety device. The latter prevents the maximum speed being exceeded and ensures a proper diminution of speed as the cage approaches the bank. If the speed exceeds the specified maximum at any point, the brake is automatically applied, the current being at the same time cut off. Moreover, below this safety device, and connected directly to it, is a so-called retarding apparatus, which automatically switches off the electric energy by gradually turning back the lever of the starting gear, in case the attendant has neglected to do this, as the cage approaches the bank.

The gradual application of the voltage is attained by dividing the storage battery into four groups, and switching these groups in step by step, using small starting resistances between the groups.

The order in which the individual groups are switched in varies in alternate trips, first the one terminal of the whole battery being used as the fixed motor terminal, and then the other, or, as we may say, the battery is discharged from right to left when the cage is ascending, and from left to right when the other cage ascends. The various groups and cells will be thus subjected to as near as possible the same working conditions. A small number of cells at each end of the battery can be switched in individually. These are used for manœuvering, especially for the small movements necessary to unload the various stages of the cage at a single



DETAILS OF ELECTRICALLY DRIVEN HOISTING MACHINE, GELSENKIRCHEN, GERMANY.

platform. These cells are charged by means of a special small boosting dynamo. The small and yet liberally designed starting resistances are combined with the above-mentioned starting switch gear under the motor driver's position. This starting gear, of cylindrical form, carries on its outer periphery the switch contacts, in front of which the rotating switch arm moves. The starting gear consists of two perfectly separated starting resistances. At a speed of twenty metres per second each motor has its own starting resistance, but at ten metres per second, the two motors being in series, only one starting resistance is used, thus ensuring a perfect reserve. In addition to this the starting resistance is so arranged as to allow of various reserve connections being introduced by means of the grouping switch in the room above. It is thus possible, if one motor breaks down, to continue work with the other, and, further, to connect either of the starting resistances with either of the motors. It is provided for that the work can be continued with the battery cut out, in case the two starting resistances are connected in series as in a common starting resistance for the two motors, which are likewise in series.

The vertical axle of the starting gear is continued upward through the arched foundation and receives its movement through a rack and pinion from the pneumatic auxiliary regulating gear in the room above. The latter consists in the main of two cylinders, the working cylinder and the dashpot cylinder, bolted to a common centre block, and in which, connected simply by means of the piston rods, the pistons travel. These are also connected to the driving rod.

The working piston is put into motion by means of compressed air, the dashpot piston serving to damp and arrest the motion.

The compressed-air gear is worked on the differential system, in which the movement of the driving piston rod is used to bring the valve back to its centre position.

The valve gear is contained in the steering block in front.

The pneumatic engine is set in motion by moving the switch lever. The path of the working piston corresponds exactly to that of the lever in the steering block slot.

In the position of rest, the lever leans toward the attendant; from this position it is first moved either to the right or left, thereby actuating, through a compressed-air transmission, the switch gear in the rear, which determines the direction of rotation of the motors. Thus, when the lever is in the right-hand slot, the right-hand cage ascends, and *vice versa*.

In addition to the switch lever, the steering block has a brake lever actuating the pneumatic brake. This brake lever has a stop which only allows of its motion when the switch lever is in the no-current position.

The pneumatic brake, distinguished by a brake cylinder fixed vertically in front of the hoisting machine and actuating the four brake blocks by means of simple levers, differs very little from the usual steam brakes used with steam winding engines. As already mentioned, this can be actuated not only by the hand-lever, but also by the safety apparatus, which at the same time cuts off the current. In addition to this, the main brake lever can be worked through a gravity screw brake which is fixed under the floor, the observer above seeing only a cast-iron pillar.

The pillar carries the weight-releasing lever, which can be worked by the attendant in the case of the failure of the pneumatic brake. The pillar contains also a winch for winding up the fallen weight.

The Production of Platinum.

The production of platinum for domestic ores in the United States in 1901, according to the report of Dr. Joseph Struthers, in mineral resources of the United States, 1901, now in press, United States Geological Survey, was 1,408 ounces, valued at $27,526, as compared with 400 ounces of crude platinum, valued at $2,500, in 1900, a notable increase, although the total quantity so produced was but a small part of the total domestic consumption for the year. The production during 1901 was the largest annual output on record since statistics of platinum produced from domestic ores were first compiled in 1880. The next largest output was in 1890, when 600 ounces, valued at $2,500, were produced. In connection with the production of platinum from domestic ores during 1901, there were obtained also 253 ounces of iridium, a metal so closely allied with platinum in its properties that doubtless it has formed from fifteen to twenty-five per cent of the reported platinum production in early years.

The domestic supply of platinum in recent years has been obtained as a secondary product chiefly from gold placer deposits in Trinity and Shasta counties, California. The occurrence of the metal has been reported from California, Oregon, Washington, Idaho, Montana and Alaska. Sperrylite, the platinum arsenide mineral, has been reported from Macon County, North Carolina.

Platinum and other metals of the platinum group, osmium, palladium and iridium, were discovered in 1901 in the copper ores of the Rambler mine, near Encampment, in the Medicine Bow Mountains of Albany County, Wyoming. The platinum content of the ore varied from 0.06 to 1.4 ounces per ton.

The imports of platinum during 1901 were valued at $1,695,895, as compared with $1,762,020 in 1900. The world's annual production of platinum for the last few years has ranged between 160,000 and 170,000 ounces, of which Russia supplies about 150,000 ounces, the remainder being obtained mainly from South America.

The price of platinum reached $21 an ounce in the latter part of 1901, and the demand is still in excess of the supply.

Dr. David T. Day has detected platinum in the auriferous sand at Corozal, Porto Rico. This is the only definite report of platinum in the West Indies, except the old discovery in Santo Domingo.

Standards in Ewing's Hysteresis Tester.

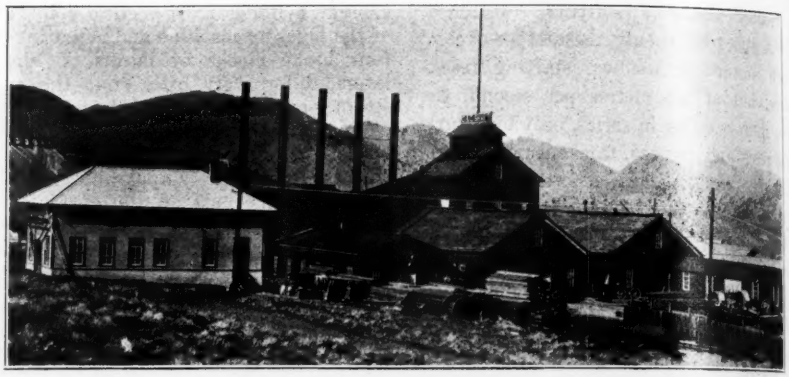
Professor J. A. Ewing has issued the following notice to users of his hysteresis tester: "In the testing of iron and steel stampings for hysteresis by means of my hysteresis tester, the hysteresis of the sample is found by comparison with two or more standards whose hysteresis is known. Experiments which have recently been made here lead me to doubt whether in all cases the standards maintain their quality so well as I have hitherto supposed, and it now appears desirable that users of the instrument should see that the values of the hysteresis which they assume in their standards are checked from time to time. If this precaution is taken, the apparatus may be relied upon to give consistent and accurate results."

Of the three royal prizes offered by the Reale Accademia dei Lincei for the year, that for physics has been awarded to Professor Cantone, of Pavia, for his researches in the phenomena of elastic equilibrium outside the limits of Hooke's law. Professor Cantone has obtained phenomena in elasticity closely resembling the phenomena of magnetic hysteresis, which are appropriately described as "elastic hysteresis," and the laws of which account for a large number of observed facts. Under the Santoro foundation, an extraordinary prize has been awarded to Mr. Marconi, who, Signor Blaserna remarks, "is generally recognized as the first who had the fertile idea of making use of Hertzian waves, not for sending signals to a distance of a few metres, as had already been done by Righi, Lodge and other investigators, who deserve the credit of having first started in this direction, but for making them the basis of a system of telegraphy properly so-called."

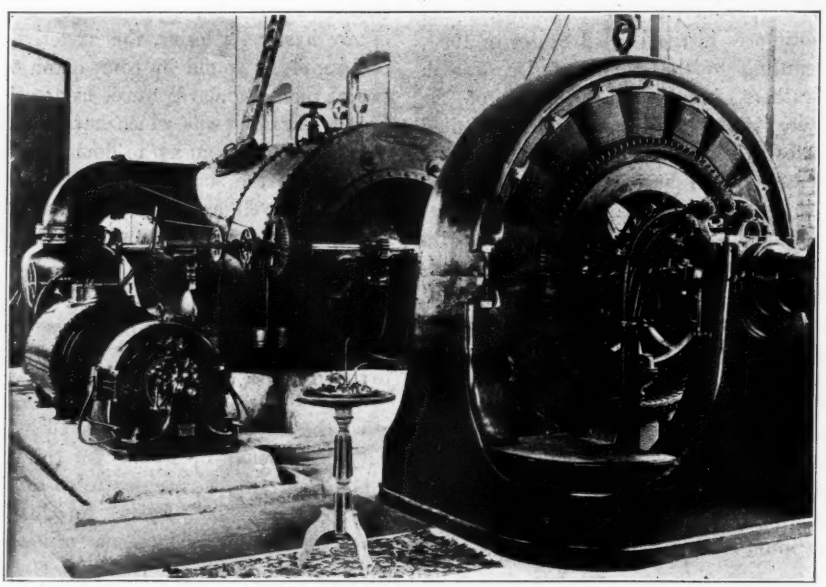
Electrical Equipment of the C. & C. Shaft of the Consolidated California & Virginia Mining Company, Virginia City, Nevada.

By Leon M. Hall.

WHEN the mining properties on the Comstock Lode were first developed operations were carried on by means of steam-generated power, wood being used as the fuel. This was very costly on account of the scarcity of wood. The milling was, until quite recently, done at a distance of some fifteen miles from the mine, at a point on the Carson River where cheap water power could be obtained. About two years ago the question of electrical transmission for the purpose of supplying power for deep mining operations on the Comstock Lode was taken up and since then extensive hydraulic developments have been carried out at Floriston, Cal., on the Truckee River. Power is now transmitted thirty-five miles to the mines in Stotey County, and a dozen or more of the properties have been equipped with electrical machinery. Among these is the C. & C. shaft of the Consolidated California & Virginia Mining Company, which has a world-wide reputation as a bullion producer.

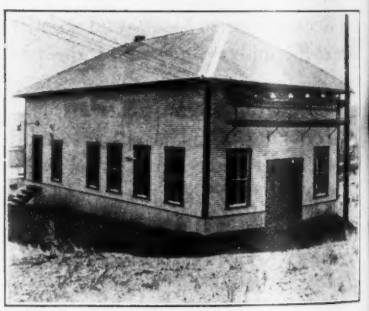


Shaft and Buildings of the Consolidated California & Virginia Mining Company.



Alternating-Current Generators, Direct-Coupled to Water-Wheels at Floriston, Cal., Power-House of the Truckee River General Electric Company.

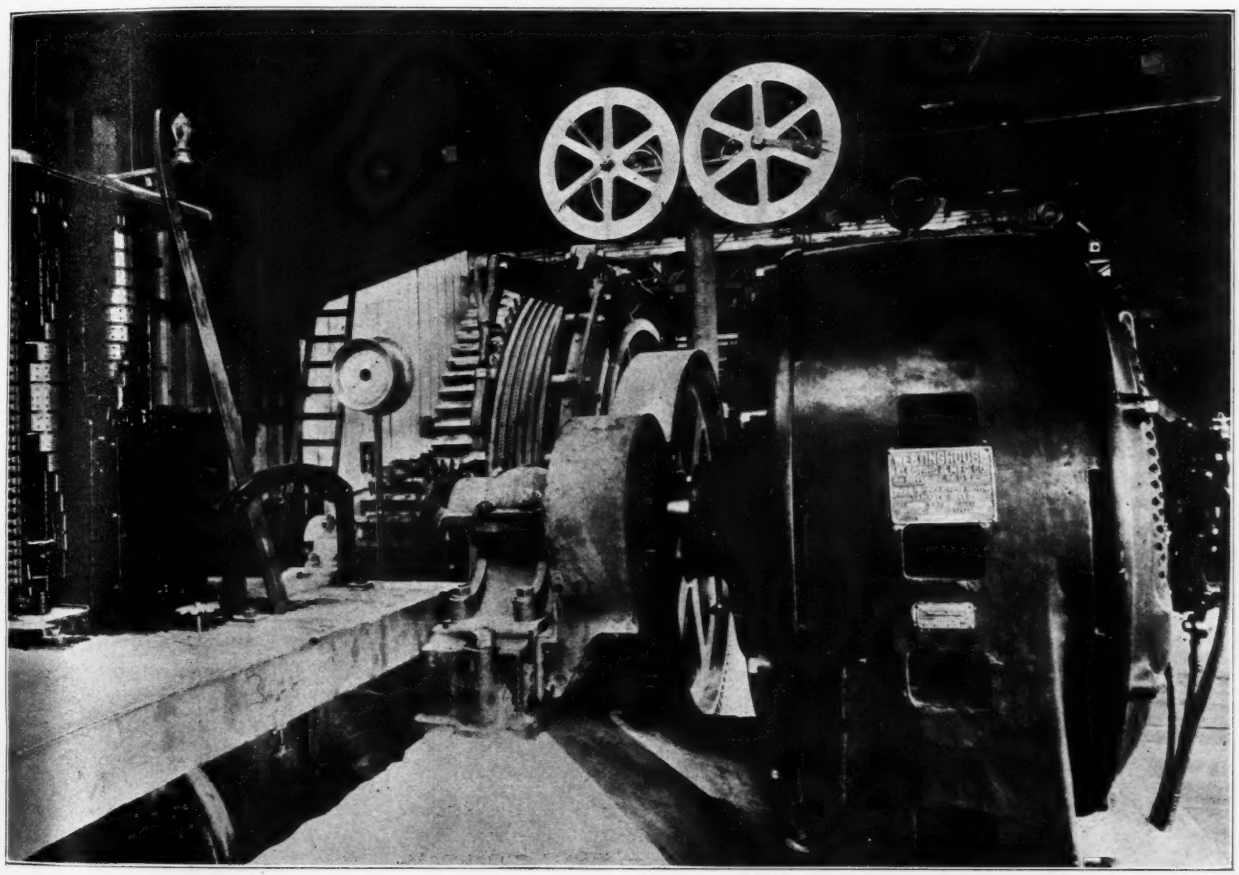
The power plant on the Truckee River is about two miles east of Floriston. The river is dammed just below the Floriston Pulp and Paper Mill, and the water is conveyed about 600 feet through a canal and then 8,600 feet through a wooden flume 6 feet 8 inches high and 10 feet wide, to a point directly above the generating station. It is then conducted through two wooden stave pipes 160 feet long and 6 feet in diameter to the wheels, upon which there is a head of 84½ feet. There are two pairs of 27-inch horizontal McCormick turbines direct-connected to Westinghouse, three-phase, sixty-cycle generators of the revolving armature type. These generators are separately excited by two 22½-kilowatt, direct-current machines. The wheels will each develop 1,400 horse-power at 400 revolutions per minute with the above head of water. They are regulated by two type "B" Lombard governors. Current is generated at 500 volts and is raised to 24,000 volts by means of six 300-kilowatt, Westinghouse, oil-insulated transformers, at which potential it is transmitted thirty-three miles over a double circuit of No. 4 hard-drawn copper wire to the substation at Virginia City. The line is composed of square redwood poles 30 feet in length, with pine cross-arms and locust pins, upon which are mounted 7½-inch Locke insulators. The telephone circuit is carried on the same poles by oak brackets with pony insulators. At the substation, at Virginia City, the potential is lowered to 2,300 volts by means of six 450-kilowatt, Westinghouse, oil-insulated transformers, and at this potential current is distributed to the various mining companies. The distribution circuits are composed of weather-proof wire and are designed for four per cent drop under full load. The generating station at Floriston is constructed of brick with a galvanized iron roof, and the substation at Virginia City



Substation at Virginia City.

is entirely covered with corrugated galvanized iron.

The plant has been in continuous operation since October 20, 1900. The Truckee River General Electric Company sells power to the various mining companies at $7 per horse-power per month, the amount used being based on a maximum peak load of two minutes' duration. This, with other conditions, has made advisable the installation of machinery of the very highest grade and the introduction of some features which are rather unique in character. In the C. & C. shaft at Virginia City every precaution has been taken to secure thorough reliability and the highest efficiency and, after giving the following brief outline of the machinery in use, I will elaborate upon some of the more important features as illustrated in the accompanying photographs.



200-Horse-Power, 2,200-Volt, Variable Speed, Three-Phase Induction Motor, Driving Continuous Rope Hoist.

The electrical machinery in operation on the surface consists as follows: One 200-horse-power, 2,200-volt, variable speed, three-phase, Westinghouse induction motor, geared to balanced electric hoist, which will be described later; one 100-horse-power, 2,200-volt induction motor, belted to a 16½-inch by 30-inch, single-stage air compressor; one 30-horse-power, 440-volt induction motor, operating circular saws; one 15-horse-power motor of the same type driving tools in the machine shop; one 10-horse-power motor operating a Blake rock-breaker at the ore-bin; three 15-kilowatt, indoor-type transformers, transforming from 2,200 volts to 440 volts; one 5-kilowatt lighting transformer, transforming from 2,200 volts to 110 volts; two Manhattan arc lamps; fifty incandescent lamps, together with necessary lightning arresters, fuse blocks, cutouts and switches.

The apparatus underground consists of the following: One 15-horse-power induction motor, operating at 440 volts and driving a fan on the 250-foot level; two ten-horse-power motors of the same type, driving fans on the 1,950-foot and 2,150-foot level; three 225-horse-power motors operating at 2,200 volts, and geared to three duplex double-acting Reidler pumps located on the 2,150-foot levels; three 10-kilowatt transformers, transforming from 2,200 to 440 volts, located on the 1,750-foot level; one 3-kilowatt lighting transformer, transforming from 2,200 volts to 110 volts on the same level; three 15-kilowatt transformers, transforming to 440 volts, on the 1,950-foot level; two 5-kilowatt lighting transformers, transforming from 2,200 volts to 110 volts, on the same level; three 10-kilowatt transformers, transforming to 440 volts, on the same level; one 5-kilowatt lighting transformer, transforming to 110 volts, on the same level.

These are all Westinghouse transformers and supply the motor and lighting circuits within the mine.

There are 250 sixteen-candle-power incandescent lamps scattered through the workings underground. A No. 6 Brown & Sharpe three-conductor lead-covered cable armored with iron wire extends from the surface to the 2,150-foot level, and a No. 0 three-conductor cable to the pumps on the same level. The weight of the No. 6 cable is six tons and of the No. 0 cable ten tons. The cables were lowered down the shaft by means of the hoisting rope and then securely clamped to the wall plates. At each station a water-tight junction box is used and the lead covering sweated into a tight-fitting sleeve located in the side of the box.

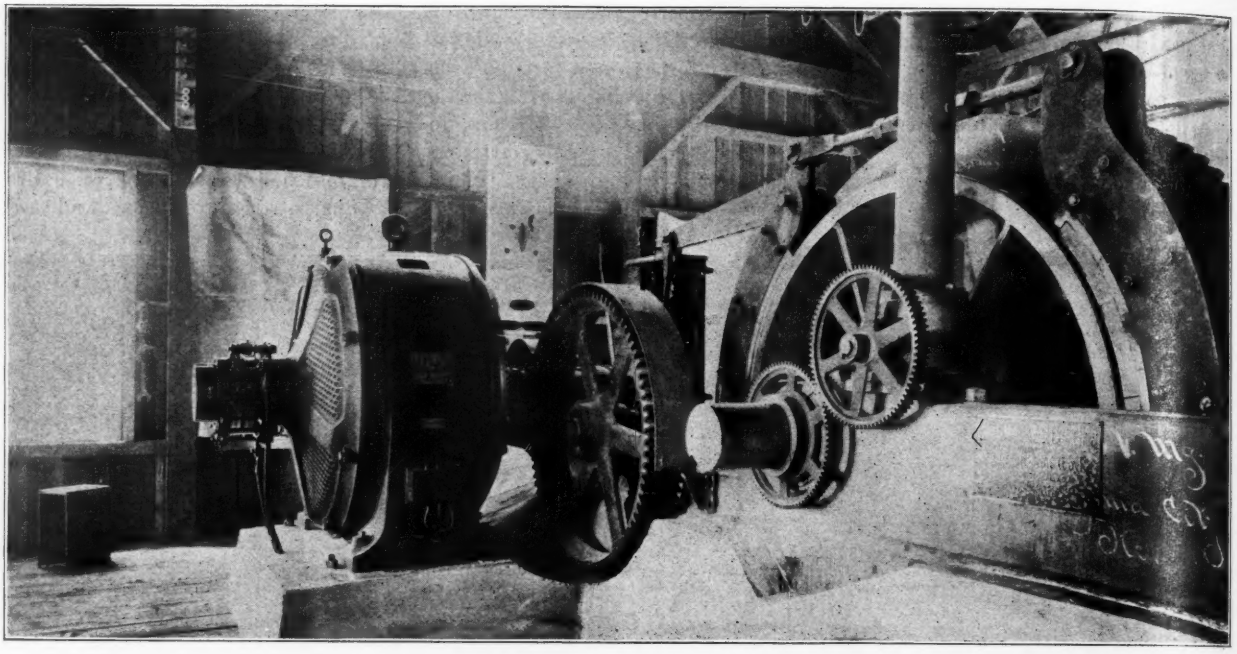
The power is brought into the works over two separate circuits, each of which is provided with a single-pole switch at the entrance of the building and, also, a

Westinghouse integrating wattmeter with its transformer. The pump circuit is further equipped with an ammeter, a frequency indicator, a power-factor indicator and a static ground detector. Oil-break switches are used on the cable circuits and upon all of the 2,200-volt motors. The smaller motors, both on the surface and underground, are equipped with auto-starters, quick-break switches and slate-base fuse blocks. Some of these machines are located in warm places and operate under severe conditions.

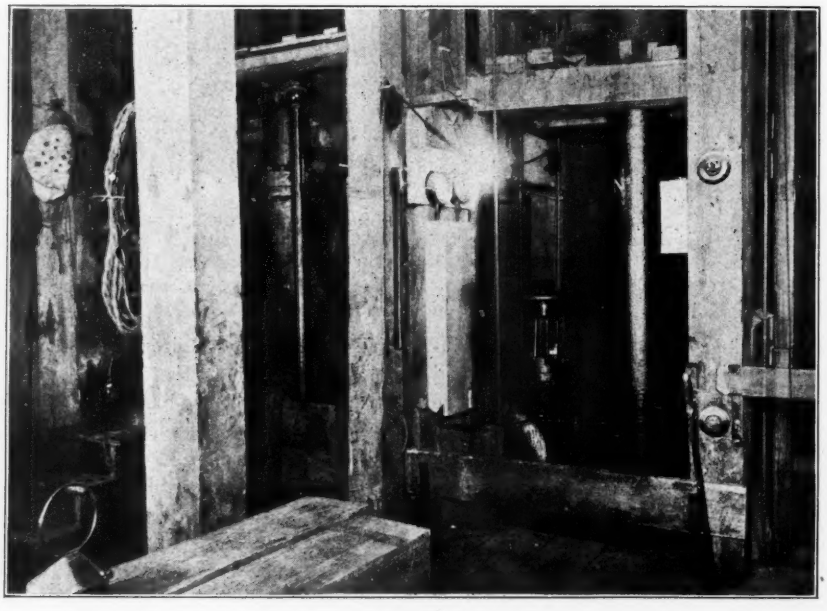
The entire installation is wired with lead-covered cables or with rubber-covered copper wire mounted on glass insulators or porcelain knobs. The greatest care is used in installing the wiring, with the result that it is safe and gives absolutely no trouble. Candles have been entirely discarded, incandescent circuits having been carried directly to the working faces and into the stopes. The current is taken into the mine at a potential of 2,200 volts through the cables above mentioned, and the potential is lowered in the mine by transformers which are located as near as possible to the point of consumption.

The compressed-air plant, supplying air for drilling, a number of underground hoists and the hydraulic pump, consists of a 16½-inch by 30-inch Rand & Waring single-stage air compressor, driven at seventy-three revolutions per minute by a 100-horse-power, type "C" Westinghouse motor. The motor speed is 580 revolutions per minute, which is reduced by a countershaft with wooden rim pulleys and rubber belting. No automatic regulator is used at the present time, as the compressor is working to its full capacity and the motor is developing ninety-six horsepower.

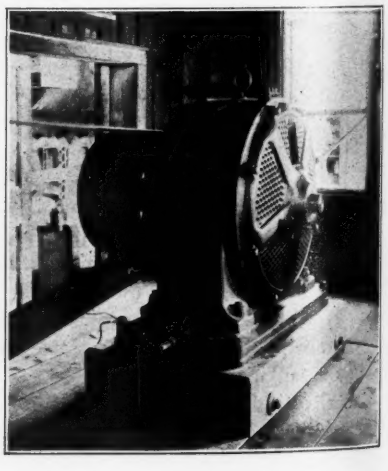
The electric hoist is a decided departure



Continuous Rope Electric Hoist, Driven by 200-Horse-Power Motor.



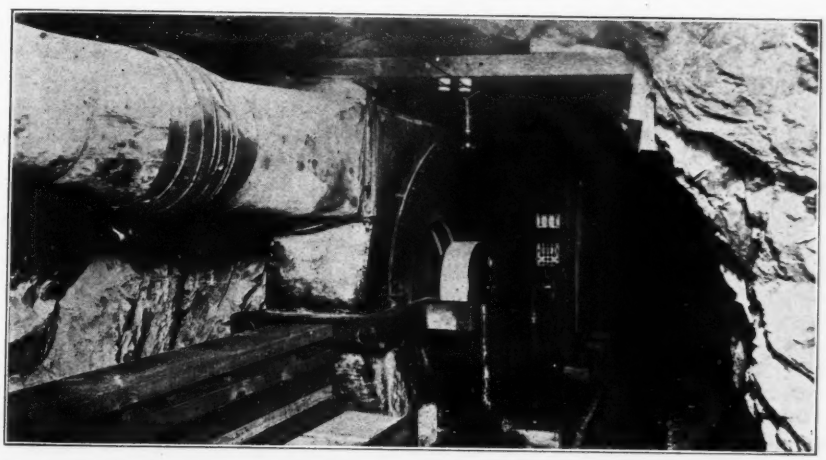
The 2,150-Foot Station, Where There Are Installed Three 225-Horse-Power Electric Pumps.



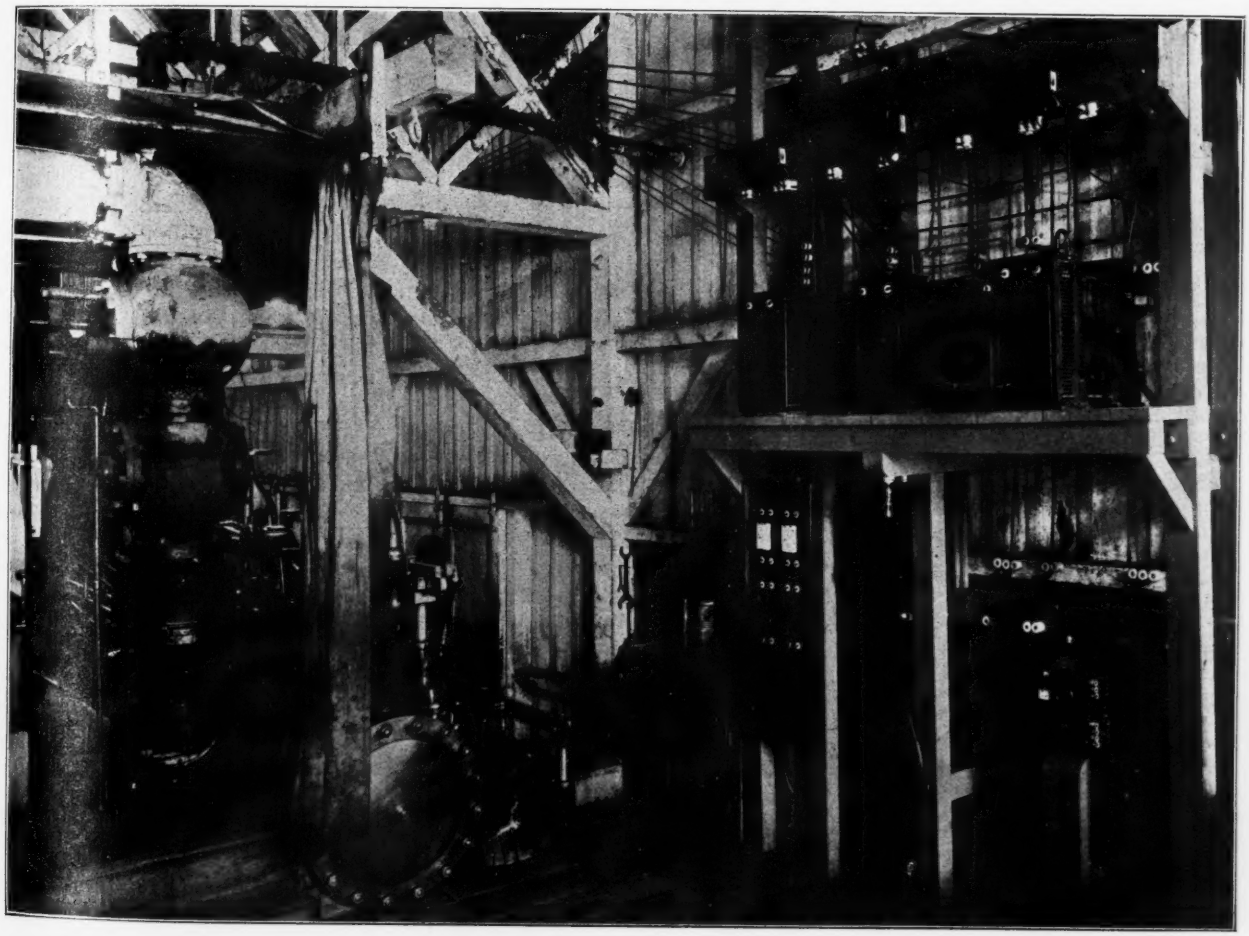
100-Horse-Power Motor Belted to Air Compressor

from usual practice in deep mine hoisting plants and embodies what is commonly known as the balanced, continuous or tail-rope system. This was adopted in order to reduce the cost of operation, and also the size of the motor to the lowest size compatible with the duty required—*viz.*, to hoist 500 tons daily from the 2,500-foot level by means of double-deck cages carrying 3,600 pounds of rock. The hoist consists essentially of a main driving drum and an idler, around which is wrapped a 1⅛-inch plow-steel wire rope. The rope passes down one compartment around a movable tail sheave and up the other. One cage is inserted between the ends of the rope and the other fastened to it by means of heavy iron clamps. The main driving drum is geared to a 200-horse-power, type "F," variable speed, Westinghouse, three-phase induction motor which operates at a maximum speed of 580 revolutions per minute moving the cages through the shaft at 1,250 feet per minute. The speed of the motor is readily controlled by means of variable resistances inserted in the secondary winding, but external to the motor itself. The variation of the resistance is accomplished by the use of a special controller resembling an ordinary street-car controller; the primary circuit is controlled by means of an oil-break switch. The hoist is equipped with heavy post-brakes, hydraulically operated, and the machine is handled with remarkable ease.

In tests that have been made these hoists show a net efficiency of about seventy-five per cent, counting all electrical and frictional losses. The pumping plant consists of three duplex, double-acting 6¼-inch by 24-inch Riedler pumping engines, located on the 2,150-foot level. These pumps take their water supply from a tank on the east side of the shaft just below the 2,150-foot station. Each pump is separately driven by a 220-horse-power, type "C," 2,200-volt,



Induction Motor Driving Blower at 2,150-Foot Level.



Transformers for Small Motors, Installed in the Building at the C. & C. Shaft.

Westinghouse induction motor, and has a capacity, at 110 revolutions per minute, of 1,500 gallons per minute to the height of 450 feet or to the Sutro tunnel level.

The motors run at a speed of 495 revolutions per minute, the necessary reduction being obtained by the use of cut gearing with stepped teeth. The total capacity is 4,500 gallons per minute and is intended to take the water from the hydraulic elevator as long as it is used as a sinking pump.

The pumps are located in a station 30 feet north of the shaft. This station is cut from the solid rock and is 18 feet by 17 feet 8 inches in section and 110 feet long. It is timbered with 14-inch by 14-inch pine timbers with 3-inch planking. A drift 5 feet by 10 feet 6 inches in section connects it with the shaft, and ventilation is obtained by means of a small electrically driven blower. The motors are all wired with lead-covered cable and the station is lighted with incandescent lamps. A ten-ton hand-crane travels the entire length of the station so that the labor of handling and installing machinery has been reduced to a minimum.

This plant is undoubtedly one of the best and most complete mining installations in the world, and its operation has been entirely satisfactory both in regard to economy and reliability. Up to the time when electrically transmitted power was adopted, the cost of motive power was never less than $20 per horse-power per month, while under existing conditions it is reduced to $7. For example, the cost of operating the 100-horse-power air compressor usually averaged about $1,800 per month, while to-day it is only $672. The entire plant was installed according to my plans and specifications and under the able direction of Superintendent Joseph R. Ryan. It has proved an unqualified success from the very beginning.

When cleaning out a steam boiler the lighting of the interior is a very important matter. Open lamps in a boiler are a danger, in consequence of the very little room to move about and the risk of the workman setting his clothes on fire. Easily inflammable lamps, such as kerosene or gasoline, are liable to explode, and the explosion of a lamp in a boiler is more serious than elsewhere, for it is harder to get away from it. The common oil lamp, by its production of smoke, soon makes the interior of a boiler unendurable. An electric lamp has been designed for the interior of a boiler, which can be very easily adapted wherever an electric lighting system is in use. An ordinary incandescent bulb is attached to an insulated, flexible conductor of sufficient length to use it in any part of the boiler. The conductor is attached to the lighting system in the usual way. As there is nothing on the inside of a boiler to hang a lamp on, the bulb is fixed on an electromagnet, so that it can be stuck upon any part of the ironwork. The incandescent bulb is covered with wire work to prevent it being broken.

STATISTICS OF ELECTRICAL PROGRESS.

Acting in the capacity of expert special agent of the division of manufacturers of the Census Office, Mr. Thomas Commerford Martin, of New York, has prepared an exhaustive report on the manufacture of electrical apparatus and supplies according to the returns of the twelfth census. This is the first report made at any census on the subject of electrical apparatus and supplies.

The present report is the first in which, through the agency of the governmental mechanism of any country, an attempt has been made to reach a definite idea of electrical manufacturers whose product subserves the immediate needs of the great agencies supplying the public with electric intelligence—light, heat, power, transportation, etc., entering into the service of mankind through innumerable channels of comfort and convenience. It is obvious that the task presents many difficulties.

Turning to the statistics of the manufacture of electrical apparatus and supplies we find that 189 establishments were engaged in this manufacture, increasing to 580 in 1900, an increase of 206.9 per cent, while the capital increased from $18,997,337 to $83,130,943, or 337.6 per cent. Other increases during the decade were as follows: Wage-earners, from 8,802 to 40,890, or 364.6 per cent; total wages paid, from $4,517,050 to $20,190,344, or 347 per cent; miscellaneous expenses, from $1,154,462 to $6,788,314, or 488 per cent; cost of materials used, from $8,819,498 to $48,916,440, or 454.6 per cent; value of products, including custom work and repairing, from $19,114,714 to $91,348,889, or 377.9 per cent.

The 580 establishments report 384 proprietors and firm members, but do not give the number of stockholders. There were 516 officers of various corporations and 4,471 superintendents, managers, clerks, and salesmen. All these are salaried employés, as distinguished from wage-earners. In the latter category the greatest number employed at any one time during the census year was 50,389, and the least number 32,582.

It is to be noted that 19 states are separately enumerated in the general returns, New York leading the list with 134 establishments, Illinois coming second with 82, and Ohio and Pennsylvania closely contesting third place with 64 and 63, while Massachusetts has no fewer than 54. On the other hand, in gross value of output Pennsylvania heads the list with $20,967,587, as compared with $17,697,352 for New York, $11,641,177 for Illinois, and $8,259,612 for Massachusetts. New Jersey has also an excellent standing as a producer of electrical apparatus, with 35 establishments showing a value of $7,380,139, or more than Ohio, with $7,036,103. The preponderance of the eastern states in the field of electrical manufacturing is shown by the fact that the 6 states—Pennsylvania, New York, New Jersey, Massachusetts, Rhode Island and Connecticut—with 316 establishments, produced goods to the value of $59,470,637.

The total number of dynamos manufactured in 1900 was 10,527, of a total horse-power of 770,832, and valued at $10,472,576. Of these 9,182 were direct current, the horse-power being 428,601 and the value $6,297,925, the balance being of the alternating-current type. It would appear that while the average size of the alternating-current machine was 254 horse-power, that of the direct current, considered alone, was but 47 horse-power.

The total value of dynamotors, motor-generators and boosters manufactured in 1900 was $379,747, the number being 649 and the horse-power 14,397¼. New York leads with a value of $201,665, followed by New Jersey, with a value of $82,091, and Pennsylvania third, with $51,655. The balance were divided among six other states. These figures represent as fully as could be ascertained the product of these varieties of dynamo electric apparatus built in 1900, but it would appear from enquiries that the manufacturers were not able to segregate these items; and that a large horse-power of "rotary converters" is also included in the dynamo output given above, for which no exact details are obtainable. The figures presented serve to show, however, a marked development in this class of apparatus, designed to manipulate and transform current received at substation points from main stations, and employed not only in lighting and power enterprises, but in telegraph offices and telephone exchanges.

As an auxiliary piece of electrical apparatus, the transformer has come to occupy an important place in the art of transmitting and distributing current, its cheapness, its high efficiency, and the fact that after installation it needs virtually no attention, being material elements in its favor. For the greater part of the last decade transformers were spoken of among electricians as "converters," but by general agreement, about 1900, that designation was limited to apparatus in which the change in the characteristics of the current is effected by the intervention

of rotating members. In 1890 transformers were of very small capacity, and able to furnish current only to a few lights. The census report of that year for New York enumerates specifically 7,282 transformers of a total capacity of 129,896 amperes, or about 18 amperes each, equal to 35 to 40 sixteen-candle-power lamps. The returns here presented show the production in the census year of 36,513 transformers of 407,451 horse-power, or about 11 horse-power each, equal to at least 135 lamps, an indication of the fact that the average size is now about five times greater than in 1890. The total value was $2,962,871. As a matter of fact, however, the increase in size of this class of apparatus far transcends such figures. During the census year 7 transformers of 3,000 horse-power each were manufactured at Pittsburg and installed in 1901 by the Cataract Power and Conduit Company, of Buffalo, N. Y. They are believed to be the largest in the world.

The total number of switchboards manufactured during the census year was 6,422, valued at $1,846,624. The production of switchboard for light and power is but one branch of a very large industry comprising the production of similar apparatus for telegraphic, telephonic and electric railway work. The number of switches reported separately from switchboards, and embracing all the smaller varieties of switches used either on boards or employed to operate a single piece of apparatus directly, without the intervention of a board, was 1,723,387, valued at $1,129,891.

The aggregate value of motors manufactured in 1900 was $19,505,504. Of the direct and alternating-current type the number was 35,604, the horse-power 515,705, and the value $7,551,480; for railways the number was 15,284, the horse-power 666,669, and the value $7,568,841; for automobiles the number was 3,017, the horse-power 8,220, and the value $192,030; for fans the number was 97,577, the horse-power 12,766, and the value $1,055,369; for electric elevators the number was 385, the horse-power 6,780, and the value $515,446; for miscellaneous use the number was 7,913, the horse-power 11,392, and the value $613,883.

The total value of storage batteries manufactured in 1900 was $2,559,601. The number was 11,012,035. The number of primary batteries, liquid, was 708,077, valued at $569,870, and the number of dry batteries was 1,946,688, valued at $316,013. The use of carbon is so closely associated with the development of electrical manufacturing that it has become well-nigh as essential as copper. Hardly a branch of the industry can be named in which carbon in some form is not relied upon as an auxiliary or indispensable factor, and this is true of the latest developments no less than of the earliest. The aggregate value of the production in 1900 was $1,731,248.

The arc lamp has been so long before the public, conspicuous on every main thoroughfare, that it is one of the best-known products of electrical industry. The number of open arc lamps manufactured during the census year was 23,656, valued at $276,481, while the number of enclosed arc lamps was 134,531, valued at $1,551,290.

The aggregate value of the incandescent lamps manufactured in 1900 was $4,036,112. The number of 16-candle-power lamps manufactured was 21,191,131, valued at $2,910,023; the number below 16 candle-power was 2,906,817, valued at $308,626; the number above 16 candle-power was 1,222,250, valued at $223,929; the number of sockets, bases, etc., manufactured was 12,099,400, valued at $468,279. To make up the aggregate value it should be noted that $125,650 worth of lamps, etc., was reported by establishments who reported values only.

The number of searchlights and projectors manufactured in 1900 was 8,283, valued at $225,635. These lamps are of various classes, chiefly for stage lighting, ship lighting, use in photographic night work, and military operations.

The number of decorative miniature lamps, X-ray bulbs, vacuum tubes, etc., manufactured during the census year was 397,432, valued at $72,935.

The total value of electric light fixtures manufactured during the census year was $2,665,124.

Few industries have undergone a more violent transition from a centralized control of production to unlimited manufacture of apparatus than telephony, and the period of greatest activity in this field since 1880 began with the census year 1900. The aggregate value of telephones manufactured during 1900 was $10,512,412. The number of receiver and transmitter sets manufactured was 797,246, valued at $3,570,616; the number of interior systems manufactured was 217,188, valued at $1,837,266. The number of central switchboards manufactured was 1,002, valued at $2,650,396, while a value of $1,129,398 was reported by establishments which reported values only. The value of supplies manufactured was $1,324,736. These figures would in themselves indicate the stupendous growth of a distinctively modern industry, but they are far from revealing the actual conditions. Beginning about 1894 and 1895, "independent" telephone exchanges sprang up like mushrooms all over the country, but more particularly in the middle and northwestern states, and by 1900 and 1901 they had attained a total of about 2,750 exchanges, with 700,000 subscribers and an investment of $150,000,000, apparatus being furnished by at least three-score manufacturers. It will be observed that the output of apparatus for telephone purposes in 1900 reached $10,512,412, scattered through nearly a score of states. These figures, however, are strictly those of the manufacturing side of the industry, and do not take any account of the far more striking data to be derived from a study of the subject after this apparatus has gone into service and is in the hands of the public. It will suffice to point out that in 1900 the United States showed a per capita of 1 telephone in 40, while in some places, such as San Francisco, it had reached 1 in 12, a rate that leads the world, and which has since been growing with unprecedented rapidity.

The manufacture of telegraphic apparatus in 1900 reached a total production of $1,642,266, which, in view of the magnitude of the statistics of other and younger branches of electrical industry, appears a surprisingly small figure. But the result, as thus barely set forth, is misleading as to the actual production of telegraphic apparatus. There are but few, and only two large, companies engaged in furnishing regular telegraph service to the public, and these are largely self-contained and self-supported in regard to apparatus. Not being manufacturers in the broad sense, and not making apparatus for sale the figures of the materials produced in their own shops for specific uses do not come under review. Hence, the production of telegraphic apparatus of old, familiar, standard type does not reach half a million dollars, so far as its purchase by the public and its availability in the commercial markets are concerned. On the other hand, special services, such as those connected with fire-alarm apparatus, police, district messenger, etc., show a producing of $1,231,167.

The total value of insulated wires and cables manufactured during the census year was $21,292,001, while the total value of electrical conduits manufactured was $1,066,163. The value of rheostats and resistances, electric heating and cooking apparatus, welding, etc., manufactured during the census year was $1,186,878. The value of annunciators, etc., was $224,885. The value of other electrical products manufactured during the year was as follows: Electric clocks, $132,149; lightning arresters, fuses, etc., $595,497; electrical measuring instruments, $860,265; all other electrical products, $14,634,984.

Summing up, the condition of the electrical industries at the close of the year as given in 1900 was as follows: There were 580 establishments engaged in the manufacture of electrical apparatus. These had 384 proprietors and firm members and 516 officers. There were 4,471 superintendents, managers, clerks and salesmen, and 40,890 wage-earners. The capital invested was $83,130,943. Wages paid during the year amounted to $20,190,344. The cost of the material used was $48,916,440, and the value of the products, including custom work and repairing, was $91,348,889.

THE CONSTRUCTION OF TELEPHONE EXCHANGES—XXXIX.

BY A. E. DOBBS.

DIRECT DEFLECTION METHODS.

We will now suspend our dissertation on bridge methods of finding resistances and refer back to the much older—and for measurements of high resistance or extreme delicacy as yet unsupplanted—method of measurement by direct deflection of the galvanometer.

We have this method in use in a larger number of commercial instruments than some thoughtless people suppose, as, for example, ordinary voltmeters and ammeters which are nothing more than D'Arsonval galvanometers in another form, calibrated to read in volts or amperes instead of ohms.

The oldest form of galvanometer was an ordinary compass with a coil of wire wound around it, and any one who so desires can make one of that description. All that is needed is about 1,000 feet of No. 36 wire wound into a flat coil underneath the box, the helix being at right angle to the direction of the needle, then turn the box till the needle points to zero, which in an ordinary compass is toward the north, the coil being placed at right angles to the needle will draw the needle to one side or the other according to the direction of the current passed through it. After this, by an expenditure of about $30 for a resistance and $20 more for a shunt box, it is possible to have a very fair testing set, a needle tangent galvanometer, which will be as interesting and troublesome as a new kind of automobile. Joking aside, however, such a contrivance could be used in the measurement of insulation and would probably have a sensibility of two or three megohms if the needle could be kept still long enough to take a reading. It could be steadied, however, by fixing a permanent magnet above it. One of the oldest and most sensitive forms of galvanometer is the Thompson (Kelvin), which, in a modified form, did duty on the transatlantic cables before the evolution of the present recording systems. So sensitive is this form of instrument that it is related how once, as an experiment, intelligible signals were received through the cable with no other current than that furnished by an old-fashioned copper gun cap, a piece of zinc and a drop of acid. Of course a test like this is purely spectacular, but it shows the very small amount of current required to give a readable deflection. This very delicacy operates against it, however, for ordinary commercial use, as it takes several seconds for the needle to come to rest and a very slight vibration in the building where it is located is sufficient to make a reading very difficult if not impossible. The writer well remembers the time when

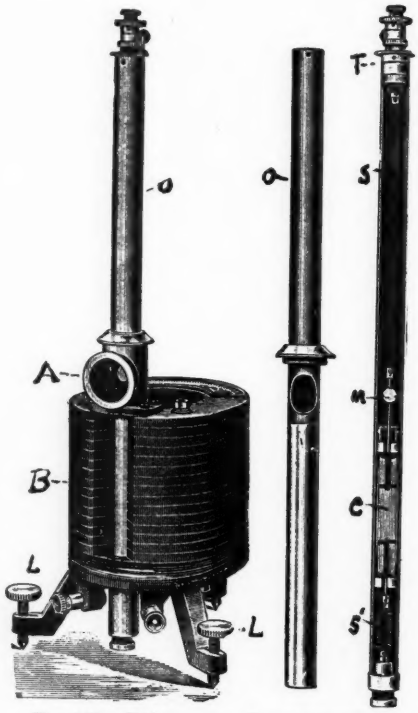


FIG. 167.—D'ARSONVAL GALVANOMETER.

wire chiefs, in making their Sunday morning tests of lines and cables, were in a state bordering on nervous hysteria; everybody in the room was strictly forbidden to draw a long breath, while to

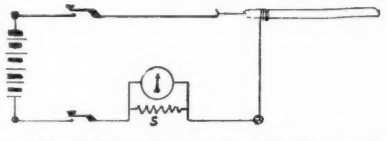


FIG. 168.—MEASUREMENT OF INSULATION RESISTANCE BY DIRECT DEFLECTION METHOD.

walk across the floor when a reading was being taken meant summary expulsion from the room and the culprit might consider himself lucky to get off that easy. All knives, pliers or other pieces of magnetic metal had to be discarded before any one was allowed to approach within viewing distance of this wonderful piece of mechanism, and where conditions permitted the test room was located in the deepest cellar and partitioned off by itself and the instruments placed on a table on a foundation of brick and cement. In passing it might be remarked that this has been found good practice, even yet, where the highest grade of instruments are used on account of their extreme sensibility.

In most modern instruments this fluctuation of the needles is dampened by causing them to rotate against the field of one or more permanent magnets, which decrease the sensibility somewhat, but at the same time permits the needles to come to rest more quickly. By surrounding them with an iron case they are also shielded against the disturbances of outside magnetic fields so that some of them can be set up in a dynamo room without seriously affecting their readings.

The Thompson and D'Arsonval galvanometers are built on different lines; in the former there is a small light mirror, to the back of which is glued four small magnetic needles suspended from a long silk thread, or rather a pair of threads, twisted in opposite directions so as not to impede the movements of the magnet mirror. This mirror is set to swing between two or four coils, and its deflection is read by means of a beam of light from a lamp which is reflected back on a scale placed at a distance of one metre away though there is no reason why it should not be thrown on a screen twenty feet away if desired.

The oscillations are dampened by a vane of mica attached to the mirror, while a bar magnet hung a few inches above the mirror gives it the necessary steadiness and is also useful in adjusting it to the zero point. As said before, however, this instrument has been almost entirely supplanted by the D'Arsonval form except for the most delicate laboratory tests.

THE D'ARSONVAL GALVANOMETER.

A cut of this instrument is found in Fig. 167, the figure to the left showing the instrument assembled; that in the centre showing the tube enclosing the moving parts (OO), while that to the right is the inner tube and the moving parts shown in detail. The moving parts are a coil C, and a mirror M, suspended from the top of the tube T by a strip of phosphor-bronze, from one and one-half to two mils in thickness; the current passes from the tube O, through the top of the tube T, through the phosphor-bronze suspension strips S, through the coil C, the coiled spring S' and out through the insulated screw tip at the bottom of the tube; a ray of light cast upon the mirror M is reflected back upon a graduated scale or a screen as the coil turns to the right or left under the influence of magnetism, the light being reflected back through the aperture A while the coil below the mirror is in the centre of the magnetic field B. The permanent magnet B is built up of thin sheets of steel, each one aged and mag-

netized separately, which ensures the greatest possible strength and constancy.

The whole instrument can be leveled by means of the leveling screws LL, and the mirror adjusted to the centre of the aperture by turning the inner tube T until the spot of light rests exactly in the centre of the object glass or scale.

The coil having a theoretical swing of ninety degrees to the right or left of the zero line, and the swing being almost exactly proportional to the current passing through it, each degree of deflection on the scale would therefore represent a certain fixed portion of current, and it therefore follows that the greater the resistance in circuit the less the current and, *vice versa*, the less the resistance, the greater the current and consequently the deflection.

FIG. 169.—SHUNT BOX, MAKING SLIDING CONTACT WITH STUDS.

In order to obtain a reading constant a standard coil is used—generally of 100,000 ohms, divided into sections of 10,000 ohms each—the galvanometer carefully adjusted to zero, and the circuit closed through the resistance coil and the deflection noted; calling the resistance of the standard coil r and the deflection d, our constant (c) becomes $c = d \times r$.

Example 1: A reading taken through a 100,000-ohm box gives twelve degrees deflection; what is the constant?

Answer: $d = 12$, $r = 100{,}000$; therefore, $100{,}000 \times 12 = 1{,}200{,}000$ ohms as the value of one degree (c).

Example 2: What would be the insulation resistance of a line giving a reading of four degrees in the above case?

Answer: This introduces a new factor, an unknown resistance which we will call X; in this connection our formula becomes $\frac{c}{X}$ which in the present case is $1{,}200{,}000 \div 4 = 300{,}000$ ohms.

Fig. 168 shows the method of measurement of insulation resistance by the direct deflection method, and also introduces another factor in our calculations, a shunt (S) across the galvanometer terminals, which is often necessary owing to the fact that where a strong battery is used—it is necessary to have a high voltage in measuring insulation—the deflection of the needle will be so great as to run off the scale unless part of the current is taken away from the galvanometer for which purpose we use a shunt taking 1, 10, 100 or 1,000 times as much current as the galvanometer and consequently multiplies the deflection reading by these proportions.

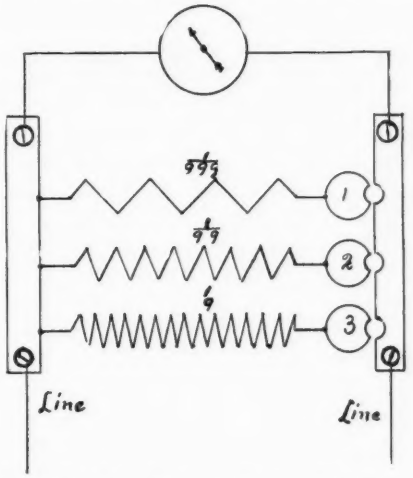


FIG. 170.—OLD FORM OF SHUNT, CONNECTED BY SINGLE PLUG.

Fig. 169 shows one form of shunt box which makes a sliding contact with the various coil studs.

These shunts may be assembled in three different forms. In Fig. 170 we have the oldest form shown connected by means of a single plug. With the plug in the hole marked 1, the shunt resistance is $\frac{1}{999}$ that of the galvanometer so that its deflection is read as 1,000 times greater than appears on its face. In the No. 2 hole, the ratio is 100 to 1, and in the third the reading is multiplied by 10. The disadvantage of using this form is that it is carefully calculated for a certain galvanometer only, and if used in connection with a D'Arsonval instrument in which a suspension wire has to be changed occasionally with a consequent liability to a slight change in the resistance there would probably be an error in the readings.

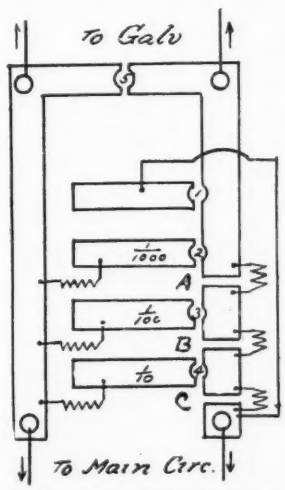


FIG. 171.—SHOWING ARRANGEMENT OF COILS.

To overcome this objection we have a later form, known as the compensated shunt, in which a certain amount of resistance is inserted in the circuit in order to keep that quantity constant.

The coils are arranged as shown in Fig. 171. By inserting a plug in 5 the galvanometer is short-circuited. In hole 1 the shunt is short-circuited and all the current goes through the galvanometer. In 2, $\frac{1}{1{,}000}$ of the current goes through the galvanometer and the rest through the shunt and the coils A, B, C, and so on with the rest.

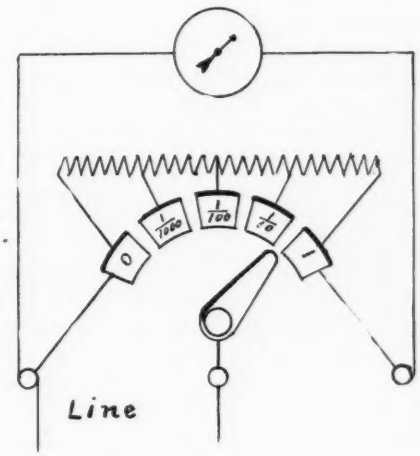


FIG. 172.—UNIVERSAL SHUNT.

Like the first, this shunt must also be fitted to the galvanometer for which it was designed or otherwise there will be an error factor.

In Fig. 172 we have the Ayrton or universal shunt which can be used with almost any galvanometer and has gradually displaced almost all the others. In the first place, no matter what the position of the plug or arm, the shunt relation to the galvanometer is constant, the ratios being all taken from the outside line. Its resistance is relatively high to that of the galvanometer, and it can consequently be changed from one to another when desired.

DEPRECIATION IN TELEPHONE PROPERTY—VI.

A SERIES OF PAPERS ON AN IMPORTANT TELEPHONE PROBLEM.

BY FRED DE LAND.

(Concluded.)

Dr. C. F. Bennett said: "When a line twenty-four miles long, between two country seats, can be built to give a good talk for $25 a mile of fence wire and fourteen-foot posts most of the way, with a total investment of $600, who can stop competition? And if it should happen that the builder has an aspiration only to control this line with salaries proportionate to the $600 investment, then who can not say that the line can charge a rate of half the admitted safe tariff and in these cases make a profit? And if he can make a profit he is not a trespasser upon territorial rights, nor is he infringing competitive rights. A business man is never out of place save when he fails to make a legitimate profit."

Mr. Frank Parker has explained how "considerable friction between owners of different exchanges lies in encroachments into each other's territory." Mr. R. S. Abbott stated that "the Grand Rapids company found it necessary to build toll lines, and in so doing have found it also necessary to buy up the various exchanges which really hampered them instead of assisting." And Dr. Lumpkin, in his address of welcome to the delegates at the Chicago convention, said: "The independent telephone business has grown so rapidly since the Bell patents expired that we are unable to keep pace with its progress, and many who did not join this great army until late in their onward march, being very anxious to cover as much territory as possible, seem to forget the rights of others and are paralleling our lines in many places through the country, and even the second independent exchange has been built in the same city."

At the Cleveland convention, Senator C. W. Kline, of Pennsylvania, said: "Another duty we owe to each other is not to infringe on each other's territory. Let each local company have the territory that properly belongs to it, and we must not attempt to parallel its lines. We must bear and forebear in the telephone world, the same as in other business matters, if we wish to succeed. We must always remember that we have a strongly entrenched opponent to fight, and we can not afford to carry on a guerrilla warfare among ourselves, or fritter away our strength in little difficulties that can easily be harmonized." Editorially, one of the telephone journals believes that "the public very properly resents bickerings among its servants by which it is invariably the chief sufferer, and independent telephone companies can find no surer way to alienate the sympathy of the public, now with them, than by quarreling among themselves."

Commenting on "a letter from the president of one independent company to the treasurer of another," an extract from which reads: "We found it impossible to float a bond issue. Neither brokers, bankers nor trust companies would touch the bonds, although we have a financial backing that is of the highest character." The editor of a telephone journal says: "The reasons given for not handling the bonds were manifold, as we learn from the same source. The lack of unity of purpose on the part of the independent companies, no standard rates, even in adjoining counties, the absence of a standardized system of construction, new companies being compelled either to buy up neighboring companies or connect new copper metallic circuits with old grounded iron wires in order to have county service."

The editor of the Chicago *Tribune*, in referring to the lecture on the law of mutual aid given by Prince Kropotkin before the High School Teachers' Club, calls attention to the reiteration of his "denial that the law of tooth and nail is the law of survival." After citing Darwin's own declaration in his second book, "Descent of Man," that those species which exhibit the strongest social sympathies stand the best chances of survival, he multiplied illustrations to show that this principle, as well as its converse, is borne out in nature. Social animals cooperating for their maintenance are incomparably more numerous in the world than those which contend against each other or pursue their life separately. The preying and lonely lion or tiger is not to be compared in numbers with the fallow deer, nor the hawk with the duck. Indeed, the species which are most destructive and exclusive in their habits tend toward extinction . . . To be assured that while strife exists in the struggle for existence, mutual aid is, in fact, the more typical and fruitful law, is to be offered an interpretation of nature which is certainly welcome to ordinary human sensibilities, as against the tooth-and-claw interpretation which has for a generation prevailed so widely in the scientific world. It is also plain that this interpretation—which Prince Kropotkin appears to have been the first to set forth and elaborate—must, so far as accepted, have a direct influence upon the philosophy of human society.

And the Hon. Thomas B. Reed has said that "human selfishness is universal, and can be curbed only by selfishness itself. Where the selfishness of a few is intrusted with unlimited power, and buttressed up by all the power of the state, formally enlisted in its behalf, it has never been able to resist successfully the selfishness of all. In other words, the selfishness of a few is always met and mastered by that greater power, the selfishness of all. The struggle may be long and may seem doubtful, but it never is so in the result."

Mr. Wells told the delegates to the national convention, at Philadelphia, that "it is my humble opinion that the independent telephone interests of the United States have much more to fear from internal dissensions and jealousies than from the competition of the Bell company, and that, for that reason, harmony should be fostered at all hazards." Surely with such an independent authority to vouch for its destructive potentiality, "internal dissensions and jealousies" ought to be considered as a factor in determining possible depreciation or lessening in value.

In view of these independent opinions it seems as if the following opinion of the editor of the *American Telephone Journal* might well be framed and hung in the office of every telephone plant in the country:

> Both as regards broad questions of policy and specific points in the conduct of the telephone business, there are many important heads on which independent telephone companies should come to a general agreement for the future good of the entire industry. They should recognize once and for all that they are not engaged in any private fight or adventure, but in the upbuilding of a great industry, in which liberal views and sound policy are absolutely necessary for ultimate success. To serve the public efficiently must be the first aim of every telephone company worth its salt, and to pursue this aim constantly implies a thorough avoidance of petty methods, of squabbles and bickerings with neighbors, of selfish and obstructive tactics, and, in general, of an attitude of aloofness from measures proposed for the general good.

Now, experience indicates that some good men are so constituted that they seem unable to comprehend that correct knowledge concerning the details of any business can only be gained through practical experience, that such experience is gained only at a cost more or less great, but that where such correct knowledge

is properly applied it goes far toward ensuring success. Hence, the cost of that knowledge may be likened to a premium paid for insurance in a business venture, for it enables a man to know his needs and to plan and build accordingly. Goethe wrote: "I respect a man who knows distinctly what he wishes. The greater part of all the mischief in the world arises from the fact that men do not sufficiently understand their own aims. They have undertaken to build a tower, and spend no more labor on the foundation than if it were a hut." And President Roosevelt in his message to Congress declared that "the slightest study of business conditions will satisfy any one capable of forming a judgment that the personal equation is the most important factor in a business operation; that the business ability of the man at the head of any business concern, big or little, is usually the factor which fixes the gulf between striking success and hopeless failure."

Professor J. C. Kelsey says:

In past days there were few telephone exchanges, naturally giving poor service, with apparatus not worthy of name; hence the uselessness of having a well-trained technical man, or any man of ordinary ambition, waste his prospects and life working about a junk shop. The pay was poor, because the demands of telephone engineering simply called for the service of a lineman. He could connect an instrument, and could call Central with full consciousness that the amazed public was watching his wizard-like occupation. But in these days the idea is fast gaining ground that this man, reckless of life and limb and property, who will stick his handaxe blade into a tin roof handle up, so it won't be so hard to pick it up again, is not always a fit man to handle an exchange. If the company entrusted him with an amount of money, say, $30,000 or $150,000, to invest, one would say the company was mad. Yet this same company will give a careless, ignorant man the full investment of a $30,000 or $150,000 telephone plant and not feel a bit uneasy.

Mr. Frank Parker, the well-known independent, says: "This one feature (cheap construction) perhaps has done a great deal toward giving patrons the idea that independent exchanges are 'one-horse affairs' . . . All these troubles come from lack of knowledge of telephone requirements, and people will outgrow them in time, but we mention it to emphasize the fact that telephone construction has risen to a point where it requires both technical and telephone business experience in order to make it a success."

This "lack of knowledge of telephone requirements," that Mr. Parker refers to, is due to several causes. First, to the same false belief that prompted the advocate of municipal ownership in Evansville to say that "the cost of superintendence would be nothing (of a telephone plant costing $250,000) if added to the present duties of the city electrician, who would not even then be overworked;" second, to the limited number of practical telephone men available for independent plants; and, third, to the absence of practical literature covering management and operation and maintenance. Only two months ago the editor of the ELECTRICAL REVIEW said that "the telephone of all branches of electrical engineering has the least literature, and probably presents the most attractive field for the writing of articles and papers. The average general electrical engineer is very little acquainted with telephone phenomena, and they form practically a new and unknown field, lying outside of the experience of the majority of members of the Institute."

Last December Mr. Abbott, of Cleveland, showed how "there has been no connected exposition of the principles which govern the mutual relations of the various parts of a plant necessary to telephonic service on a large scale, in such a manner as to enable the engineer to so proportion the quantity and quality of the essential apparatus as to produce an installation that will give the best service with a minimum initial investment, and aid the operating manager to so prosecute the business as to ensure satisfactory service with the least annual expense," and then he shows why there is no connected exposition. "The reasons for this absence of literature are not far to seek. Telephony as an art is less than a quarter of a century old, and those engaged therein have had to feel their way step by step, usually so handicapped by the demands of a business that was increasing too fast for experience to overtake, as to lack the time and opportunity to record the lessons that actual practice inculcated."

Commenting on the importance and difficulty of the duties of the telephone engineer as contrasted with other electrical engineers, the editor of the ELECTRICAL REVIEW said:

It is a curious fact, though one not generally known, that in an installation costing a given sum of money more engineering work has to be done if the plant happens to be a telephone exchange than if it is any other variety of electrical engineering installation. The telephone engineer has to consider a vast complexity of circuits working almost under limiting conditions of delicacy of current, and he has to maintain large numbers of small but complicated and delicate fixtures in premises over which he has no immediate control. His exchange is almost infinitely more complicated and difficult to design than a lighting station and he has to struggle also with an element which does not enter the work of his colleagues in other branches. This is the time element. In an ordinary central station the problem is to maintain the proper electrical pressure on the mains and enough capacity to supply the demands upon the plant. In the telephone exchange, however, not only must circuits be maintained and instruments kept in working order, but the operation necessary in meeting the demands of a customer must be conducted in the absolute minimum of time. In other words, the telephone engineer has to struggle for efficiency not only in his apparatus and appliances, but also in the large force of operators, inspectors and other employés. The telephone man, however, must not only know his own work, but he must be sufficiently familiar with that of the electric light or railway station to avoid the multiplicity of trouble which may easily come through some entanglement of his lines with theirs. In a modern exchange, too, he must be learned in such subjects as rotary converters, storage batteries, motor-dynamos and in a bewildering variety of applications of electricity not immediately pertinent to his own subject.

At the Waupaca meeting Mr. Hutchinson told the members of the Wisconsin Independent Association that in

Looking at the business of independent telephone companies from the standpoint of success, their management heretofore has not been all that could be desired, and I am not aware that other states have made much further advancement than has been made by the companies of Wisconsin. I repeat here what I have said on several former occasions, that those engaged in independent telephony are too often men who make the telephone business a side issue in their business affairs, giving it only a small percentage of their attention, and then seeking to apply the same principles which are applied to other business. It is a fact that the dangers and pitfalls which menace the success of the independent telephone companies in the future are not those created by the warring competition of the Bell company and its allies, but rather by those men connected with the independent telephone companies who seek to control their management by rules inapplicable to the telephone business.

At the National meeting in Philadelphia, Mr. L. W. Stanton forcibly expressed his belief that "with the millions there are invested and the opportunities there are open, it is a crime to the independent telephone interest that a little closer union and more uniform equipment

are not adopted." And Dr. C. F. Bennett told his independent friends in Iowa that "in business the man who commands the knowledge and the faculty of applying it to the work of those under him has a portion of the world at least under his control. And he it is who has the arrangements, the permutations and the combinations of the telephone world under his control. They are unmanageable save to him who, in his zeal and skill, is still willing to forego the comforts of ordinary ability for the satisfaction of seeing great works accomplished. And these men ask and deserve great salaries for great accomplishments, which is a factor in this matter of profits which goes to the credit of the small exchange. True, it probably is that money feels more secure in the hands of the great men, but it is still a fact that the ability to secure good men of little technical knowledge is far in excess of that to obtain the same number of good men with great technical knowledge, even were the money ready for their purchase. In other words, great enterprises are the measure of the men who execute them, and they will cost the price, which must be made a part of the work itself."

Here lies the reason for much of the "petty methods," the "squabbles," the "selfish and obstructive tactics" that handicap "measures proposed for the general good" in the "upbuilding of a great industry." The men controlling such companies are the barriers that prevent the rapid progress to prosperity of the larger participants. It would be interesting to learn just how much of this attitude may be justly attributed to the palpably false belief held by many new comers in the telephone field "that it speaks volumes as to the value of the business to know that a butcher, a baker, a candlestickmaker may form a company, as has been the rule up to the present time, build a telephone exchange, operate it against the educated brains of the great Bell monopoly, and beat them almost to a standstill in number of suscribers and profits."

Does the physician believe that a butcher, a baker or a candlestickmaker can beat him "to a standstill" in diagnosing acute cases requiring "educated brains" to comprehend and read the signals conveyed in symptoms? Does the dentist believe that the intricacies of the gold plate and the bridge, the drill and the amalgam are as the a, b, c of knowledge to the butcher and the baker? Are they not direct believers in the statement of President Eliot, of Harvard, that "it is plain that the future prosperity and progress of modern communities is hereafter going to depend much more than ever before on the large groups of highly trained men which constitute what are called the professions. . . . The real inventions and motive powers which impel society forward and upward spring from those bodies of well trained, alert and progressive men known as the professions." But do they practice what they preach? President Hutchinson told the Wisconsin independents that there is no business on earth requiring closer attention to make it a success than the telephone business, and the editor of a telephone journal added that "all the myriad details of which the telephone business is made up need executive talent of a very superior order for their proper execution and supervision, and unless such talent is employed those details will become so entangled as to clog the progress of the most promising enterprise."

There is a competition in the professions, and, too, a monopoly exercised by brains and practical knowledge. This is a natural monopoly and, to its utmost capacity, absorbs the cream of practice. There is competition in all lines of industry. But the experience of years has demonstrated that in every commercial and every industrial field where marked specialization rules, there can be but one outcome for competition. In order to win success, its output must be equal in quality or in character as well as lower in price, or it must be far superior if a higher price is obtained. Failure to fulfill these demands simply precedes financial failure. A manufacturer studies how to produce a similar or higher grade of goods at lower cost than his neighbor, and buyers are benefited. But the promoter of a duplicate public-service utility plant, ignorant of or indifferent to the actual cost of producing service, desires only to unload at the highest possible profit to himself, regardless of the burden he inflicts upon the community. More often competition points to poverty, rather than to progress and prosperity. For true competition, based on equality and scope, is rarely found in any line of industry, while false competition, based on principles and methods destructive to the higher interests of an industry or a community, is often found. Equality, character and comprehensive scope are not the playthings of an hour, subject to beck and nod; they are the products of accumulated knowledge, thought and reason; of excellent organization, careful administration, a thorough understanding of each element entering into the cost of production, as well as of the economic relations of one element to another, and of the ever-changing commercial, industrial and social demands.

Men who thoroughly understand "each element entering into a problem" do not assume "an attitude of aloofness." They organize for the interchange of knowledge, for the adoption of uniform methods, to the end that all may act as a unit, and by the resistless momentum of a solid mass accomplish the seemingly impossible. Acting as a unit, they sweep aside or crush the elements that tend to bar or disintegrate or to destroy the separate units.

Independents are working in a field of ceaseless progressive change, where all is subject to the resistless law of evolution. Shall everything in that field tend to unity of purpose and standardization of methods and means? Or shall there be a continuance of conflict and chaos, of disorganization and dissolution? The purpose and the influencing motives of the independents must be right; must make for the higher interests of a universal public utility function, or the telephone user will determine for himself the true relation of independent motive and purpose. Let the independents recall Tennyson's words: "The individual withers, and the world is more and more," and then accept the advice of Daniel Webster: "Whoever would do his duty, and his whole duty, in the councils of the government (independent movement), must look upon the whole country as it is, in its whole length and breadth. He must comprehend it in its vast extent, its novel character, its sudden development, its amazing progress, confounding all calculations and almost overwhelming the imagination."

Now, experience has taught all the larger, the broader-minded, and the successful semi-public service corporations that in the matter of supplying service to users a strict adherence to uniform methods and rates tends to strengthen and broaden the character of the service, while indecisive lines of action, differing from methods tried and approved, rarely succeed, and usually end in expensive failures.

There is some excuse for independents not understanding at the outset all the principles that may govern an industry in which they are just entering. But if the local business is to be a genuine home industry, and not "a strike against the Bell," or a scheme to unload on the unsuspecting, who can frame one practical reason for declining to admit the correctness of Dr. Herr's statement that an allowance of ten per cent per annum should be allowed for depreciation? Dr. Herr stated a fact. The truth never can be hurtful to the interests of the independent companies.

PACIFIC COAST NEWS.

NOTES ON THE DEVELOPMENT OF ELECTRIC PROJECTS.

The new electric power-house of the United Railways Company is being rapidly constructed in the North End. The brick walls are nearly completed at the end where the first unit is to be installed. The foundation for this unit has been constructed of concrete. It measures twenty-four by seventy-four feet and is seventeen feet high. A Union Iron Works engine, driving two 4,000-horse-power, General Electric, three-phase generators, will be placed on this foundation. An additional generating set of the same capacity will be installed under the present contracts. Later on the capacity will be doubled, giving the power-house a capacity of 16,000 horse-power.

The Tonopah Light and Power Company has been incorporated with a capital stock of $50,000, of which $500 has been subscribed. The directors are W. C. Watson, E. S. Watson and C. E. Elliott. The company will develop electric power for mines of the Tonopah, Nevada, district.

The Pacific Wireless Telegraph and Telephone Company will have its system connected with the Western Union Telegraph Company this week. Messages are now being sent between the wireless stations at White's Point, near San Pedro, and at Catalina Island, but commercial business will not be accepted until connections can be made with other lines.

The work is now under way on the approaches to the Vancouver Power Company's two-mile water tunnel, near Vancouver, B. C. The tunnel extends from Lake Coquitlam to Lake Beautiful. Electric power will be transmitted from the new electric station to Vancouver, B. C., a distance of sixteen miles, for the operation of electric railroad lines and electric lighting system. The contracts for the first installation of electrical machinery will be let within a month.

The Independent Telephone and Telegraph Company expects to be granted a franchise by the city council of Oakland, Cal., very shortly. The only other competitor for the franchise is M. A. King, who has an application pending for a telephone system in San Francisco. A long-distance system connecting the various exchanges is projected by Mr. King, who, it is said, will not ask for a franchise in Oakland until he is sure of success in San Francisco.

During the recent celebration of the Knights of Pythias, a special illumination consisting of 30,000 incandescent electric lights was installed along Market street. The construction work was done by the Wybro-Hendy Electric Company, of this city. Bids were requested for two different propositions; one a flat rate for the work and materials, everything being turned over to the Knights of Pythias at the close of the convention, and one for the work, the materials to remain the property of the contractor. The bids submitted were as follows: The J. M. Klein Company, $24,000 and $17,500; Electrical Construction Company, $20,150 and $17,500; the Gas Consumers' Association, $21,810 and $18,760; the Standard Construction Company, $20,750 and $17,250, and the Wybro-Hendy Company, $10,235 and $8,370. Only two bids were submitted for furnishing the electric current to operate the special lights. The bid of the San Francisco Gas and Electric Company was $3.84 per one hundred lights per night, and that of the Independent Light and Power Company was $1.19 per one hundred lights per night. The latter company was given the contract. This figure is considerably lower than that for furnishing current for any of the previous illuminations in the city. A. M. Hunt, manager of the Electric Light and Power Company, states that the work was done at cost as it was considered a matter of advertising for the city. Mr. Hunt also pronounced the electrical display as fine as anything that has ever been attempted in the way of temporary work.

President Miller, of the Edison Electric Company, states that within the next thirty days all the companies controlled by the stockholders of the Edison Electric Company, including the Redlands Electric Light and Power Company, Southern California Light and Power Company, the Lytle Creek Light and Power Company and the Pasadena Electric Company will be merged under the name of the Edison Electric Company.

Last week the Kern River Power Company awarded a contract for five 2,000-kilowatt, three-phase generators to the Bullock Electric Manufacturing Company. Contracts for the necessary transformers were given to the General Electric Company, and for two exciters to the Westinghouse Electric and Manufacturing Company. The five generators will be direct-connected to water-wheels in the company's Kernville power-house. The greater part of the power generated will be transmitted over the company's line to Los Angeles, Cal., a distance of 110 miles.

The Westinghouse Electric and Manufacturing Company has secured the contract for furnishing two 2,000-horse-power, three-phase generators for the Cow Creek plant of the Northern California Power Company, of San Francisco.

A. P. B.

San Francisco, August 20.

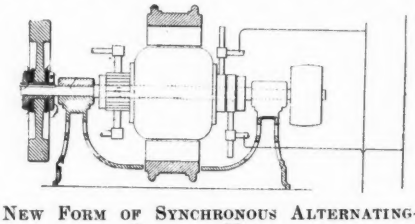
Cruvellier Surface Contact System.

A recent article in a British contemporary describes a French surface contact system which is thought to overcome the disadvantages of contact systems which use the rail return. These are given as leakage between the studs and rails in wet weather, and more or less danger to persons on the street, arising from the failure of the switches to operate. The original Cruvellier system contains two sets of studs, one connected to the positive feeder and one to the negative. The rails play no part in the distribution. There being in this system two insulated current conductors, the disadvantages due to leakages are very much lessened. In the improved system, the two studs are combined into one, and each one can be connected either with the positive or with the negative pole. The car has two sets of electromagnets, one fitted in front and the other in the rear.

There are inside the studs two systems of contacts on different axes. When the front of the car is over one stud, this is connected to the negative pole. When the rear of the car comes over the same stud it becomes positive. By an ingenious arrangement within the stud it is impossible to make contact to both conductors at the same time. The contact piece is arranged so as to make the brake positive. Tests of these studs show that they operate safely when opening a circuit carrying 250 amperes at 500 volts. The current collector consists of an endless metallic cable, which turns on two rollers that run on the ground. When the car is running, the lower part of the cable is stationary, and the current is taken up without friction. The special features of this system are: The use of two insulated-current conductors, thus reducing the leakage at the studs and removing all danger from electrolytic action to neighboring conductors; the combination of these with an effectual device to open the circuit; the use of electromagnets which do not touch the studs, and the absence of sliding contacts. Experiments which have been carried out near Paris are said to have given good results.

Electrical Patents

Mr. Alexander Churchward, a resident of Fort Wayne, Ind., has patented an improvement in synchronous alternating-current motors. The object of the invention is to overcome the difficulties encountered in operating synchronous alternating-current motors when the dynamo or generator fluctuates in speed in different parts of a revolution, as occurs when the generator is driven by an engine, the propulsive thrust of which varies at different periods of such revolution. It is commonly said that the speed of two alternating dynamos that are run in synchronism is definitely fixed by their relative numbers of field-poles, so that the two armatures make the same number of alternations per minute. It is in addition practically important that the two armatures maintain the same relative speed at all times. Thus if the generator is driven (by direct-connection or otherwise) from an engine, the speed of which varies at different parts of a revolution so that the same variations in speed are communicated to the generator and is connected in circuit with a second machine which runs at practically uniform speed (by having a very heavy flywheel or by its armature acting as a flywheel), it will follow that the phases of the two machines will be at times coincident, while at other times one machine may be in advance of or behind the other. A synchronous motor that is connected to a circuit on which the rapidity of alternation fluctuates at regular intervals tends to "pump" —that is, its armature runs sometimes a little faster and sometimes a little slower than the generator—with the result of causing a beating sound in the motor. Such pumping or beating action is usually indicative of some irregularity in the circuit feeding the motor. This irregularity may consist of variations either in speed or in electromotive force. The variation in speed of the generator tends to cause a corresponding variation in the speed of a synchronous motor. The motor can not, however, assume instantly the speed required by the new speed of the generator. When the speed of the generator increases, the motor-armature begins to increase in speed; but by reason of its lagging the motor receives an increased current, because its armature is not in normal position for the new frequency and because additional current is required for supplying the energy necessary for increasing its speed. This additional current produces a difference of magnetism of the field which must again be altered when the generator speed decreases below the average. The motor is therefore undergoing a slight variation in speed which seeks to approximate to but does not exactly correspond with that of the generator. This pumping or rocking, however, will almost entirely disappear when even a small load is put on the motor. It has heretofore been the custom to weaken the field of a synchronous motor when it was found to pump. The effect of this is to lower the electromotive force of the motor, thereby putting an artificial load on the armature which, however, while it reduces the pumping has the disadvantage of reducing the electromotive force of the generator and of upsetting the line. To overcome this defect and avoid interference with the line is the purpose of this invention. Accordingly, there is applied on the shaft of the motor or on a shaft driven therefrom, a flywheel of suitable weight, which, instead of being fixedly connected to the motor

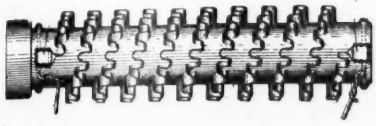


NEW FORM OF SYNCHRONOUS ALTERNATING-CURRENT MOTOR.

in the usual manner, is connected thereto through the medium of a yielding connection in the nature of a friction on brake. The effect of this flywheel is to prevent the objectionable pumping action referred to. If the generator speed suddenly increases, the armature tends to correspondingly accelerate its speed; but the flywheel lags behind, thereby putting a slight load on the motor, and then when the generator slows down the motor-armature tends to run slower, while the flywheel, tending to run at a uniform speed, catches up with the motor-shaft and forces it ahead or resists its tendency to slow down, thereby again putting a slight load on the motor. As already stated, putting a slight load on a synchronous motor extinguishes the pumping effect, this being equally true whether it is electrical by weakening the field and taking extra current, or is mechanical by throwing some additional work upon the motor. The yieldingly connected flywheel provided is of the latter order and has the effect of causing the motor to run without any pumping. Inasmuch as the load imposed by the flywheel is felt only at the instant when the variation in speed occurs, its effect in correcting the pumping is accompanied by a less loss of energy than with a load which imposes a continuous drag on the motor.

A new resistance for rheostats, electric heaters, and the like, has been invented by Mr. Harry Ward Leonard, of Bronxville, N. Y. In an application for patent, filed in the early part of 1901, he describes a support of mineral insulating material—such as soapstone, lava, slate, glass, porcelain, brick, terra-cotta—the preferred material being pottery in the form of a tube and having a conductor arranged thereon and held thereto by means of a vitreous glaze, such as enamel, having a relatively low fusing point, preferably as low as 750 degrees Fahrenheit. Such resistance tubes have been found by actual use to give highly satisfactory results; but when it was attempted to utilize tubes of large diameter to receive conductors of comparatively large cross-sectional area, it was found that the results were not as satisfactory and in many instances the expansion of the conductor was so great relative to the support that it became distorted or disarranged on the support to such an extent as to cause adjacent sections at numerous places to come into contact and thus render the device useless for the purpose for which it was intended. It has been found by experiments that this difficulty is avoided when the conductor is in the form of a thin ribbon, preferably reflexed and wound edgewise upon the tubular support, the conductor being held in position by means of the tension of the elastic metallic ribbon and being held in its final form by an attaching glaze of relatively low fusing point. Sometimes a ribbon is used which is three-quarters of an inch in width and 0.002 of an inch thick. Such a conductor has an extremely large surface as compared with a round conductor of equivalent cross-section, and hence it can dissipate by radiation and convection a very much larger amount of heat energy than an equivalent round wire. The ribbon is so thin that even when heated quickly to a bright red heat while attached by the enamel to the tube it does not produce any strain which causes the enamel to crack. The ribbon can be heated to a red heat and cooled again for an indefinite number of times without affecting the firm attachment of the ribbon to the tube. The total cubic space occupied by a resistance made in this way is extremely small as compared with any other form of resistance which would have an equivalent continu-

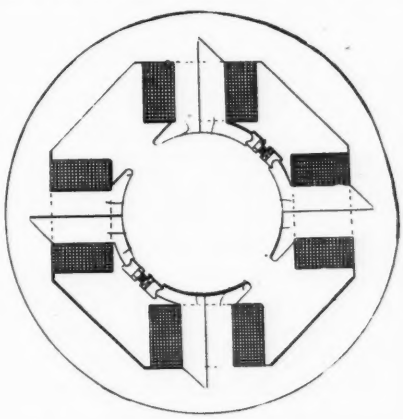
ous heat-dissipating capacity. Therefore, this form of resistance becomes very valuable for the many forms of resistances in which it is important to have a large continuous heat-dissipating capacity in a small space. The weight of such a resistance is also very little as compared with customary forms of equivalent capacity which is often a feature of value. It has also been found that the ribbon resistance can readily be attached to tubes, the diameter of which is as much as seven inches or more; but the tube preferably used has an outside diameter of from one to two inches. In the case of large tubes it is preferred to make the tubes of a material which is largely composed of



NEW FORM OF RESISTANCE FOR RHEOSTATS.

fire clay and silica. Repeated tests have shown that if two tubes exactly identical are taken and one is wound with a wire to secure the best result possible and the other is wound with the reflexed ribbon resistance, the capacity of the ribbon tube for continuous watt dissipation is about twice as much as in the case of the wire-wound tube. Sometimes the tube is wound so that it has two or more ribbons wound in multiple. This is done when it is necessary to secure low ohms and large ampere capacity. It will be seen that if the several ribbons were combined in one, the single ribbon would have to be either thicker or wider, and there is a limit to the practicable width, and it is desirable to have the ribbon as thin as possible. The multiple winding is also of advantage where wires are employed instead of ribbons. In the case of wires much better results can be obtained with two wires wound in multiple as compared with one large wire, the cross-section of which is equal to the cross-section of the two smaller wires, as will be readily understood by those skilled in the art. Hence the multiple winding has a great advantage where very low ohms and large amperes are desired.

It is a well-known practice to provide the pole-pieces of dynamo-electric machines with extensions forming enlarged end surfaces in order to cover a greater portion of the armature surface than would be covered were the cross-sectional area of the end of the pole-piece the same as that where the magnet winding is supported. Various arrangements of such polar extensions are employed, but the most common construction comprises a separate extension bolted upon the end of the pole-piece after the magnet winding has been slipped on. Such constructions, however, are objectionable, because the removal of the extension for the purpose of taking out the magnet winding is often difficult without dismantling the machine and also because the extension can not be brought to the highest degree of magnetic saturation, owing to the reluctance interposed by the cut between extension and pole-piece and the fact that the extension is not directly surrounded and magnetized by the windings. Mr. James Burke, an American, residing in Berlin, Germany, has devised a pole-piece which has enlarged end surfaces that are of the maximum magnetic intensity, and furthermore is so constructed that the extension may be readily removed to permit the insertion or removal of the magnetic windings. The integral pole-pieces of the magnetic frame are provided with longitudinal and angular offsets or recesses into which removable pieces are adapted to be fitted, the inner ends of said removable parts being beveled, while their outer ends are formed with extensions that in-



NEW ARRANGEMENT OF POLE PIECES IN DYNAMO ELECTRIC MACHINES.

crease the end surfaces of the pole-pieces toward the armature. The extensions, furthermore, serve to retain the magnetic windings in proper position. The removable parts are secured by suitable braces that may be of any form desired.

Rubber Exports from Para.

According to the final returns, writes K. K. Kenneday, Consul at Para, the shipments of rubber from the Amazon Valley this season amounted to 29,997 tons, or 2,317 tons more than in 1900-01.

In the season just begun, it is believed that a record-breaking crop will be harvested. The rubber fields of the lower river, and especially on the islands, are slowly but surely failing, both in quantity and quality; but the decrease is more than made up by the development of new fields and the expansion of the old fields on the Upper Amazon. While all the more important tributaries of the Amazon are supplying their full quota of rubber, and even making a promising increase, interest will focus in the now famous Acre territory and in southeastern Ecuador. In the regions reached by the Purus (of which the Acre is a tributary), Jurua, Beni, Madre de Dios, Javari, Ucayali, Japura and other great affluents of the Upper Amazon, which penetrate Peru, Bolivia and Ecuador, there are illimitable rubber forests as yet unexplored, which will now be gradually developed. Many seringueiros, or rubber gatherers, are headed for these regions, and it is reported that several syndicates are about to begin operations in new fields in Bolivia and Peru.

Bolivia continues to offer inducements for the colonization and development of her vast area of rich rubber and mining territory.

He is informed that the government of the state of Amazonas has granted the exclusive privilege of receiving, cutting and packing all the rubber produced in that state to one wharf company. The creation of this monopoly will injure the rubber trade of this region, but Peru, Bolivia and Ecuador will be the beneficiaries, as rubber growers and gatherers here are seeking to escape the new restrictions, which entail considerable expense and trouble upon exporters.

Shipments from Para for the period of July 1, 1901, to June 30, 1902, were 6,898 tons to the United States; 7,027 tons to Europe; a total of 13,925 tons.

Shipments from Manaos and Iquitos, from July 1, 1901, to June 30, 1902, were 7,168 tons to the United States; 8,904 tons to Europe; a total of 16,072 tons.

Shipments from Para, Manaos and Iquitos, from July 1, 1901, to June 30, 1902, were 14,066 tons to the United States; 15,931 tons to Europe; a total of 29,997 tons.

The total of crop from July 1, 1901, to June 30, 1902, was 29,997 tons, an increase over crop of 1900-01 of 8.39 per cent.

The shipments of rubber from the Amazon Valley, for the seasons of 1896-97 to 1901-02 inclusive, were as follows:

Year.	To United States. Tons.	To Europe. Tons.	Total Tons.
1896-97.....	9,848	12,368	22,216
1897-98.....	11,422	10,796	22,218
1898-99.....	12,398	12,848	25,246
1899-1900.....	12,474	14,407	26,881
1900-1901.....	15,194	12,486	27,680
1901-02.....	14,066	15,930	29,997

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

The Rating of Motors and Generators.

In every electrical undertaking, the engineer must endeavor to produce a scheme as perfect as possible, and at the same time as economically as possible. The conditions laid down in specifications may be of two descriptions—conditions of which the fulfillment can be ascertained by trials, and those with which such a proceeding is not possible. In this paper, Dr. N. G. Rasch takes up the proper rating of motors for different types of installation. He accepts in general the regulations established by the German Association of Electrical Engineers, and refers to them many times in the course of his paper. One point taken up is the question of the normal rating of the traction motor. In making a test of this, all covers and lids usually in use must not be removed, opened, or modified in any manner, nor is it permissible to replace artificially the current of air created by the displacement of the car. This point is made to compensate for the usual short time of test of the motor, as compared with that for which it will operate in service. He gives a formula which, in terms of the time during which the motor is out of the depot, the time during which the motor is working and the allowable heating of the motor, gives the proper time for which a test should be conducted. The question of testing for the performance under overload is also considered. For tramway motors, the general oponion is that an overload of forty per cent, applied for three minutes, should be regarded as insufficient. Concerning the allowable rise in temperature, he accepts the German regulations, which are: For cotton insulation, fifty degrees centigrade; for paper insulation, sixty degrees centigrade; for mica or other similar insulation, eighty degrees centigrade, these for stationary coils. The regulations further add that for a traction motor the above limits may be twenty degrees centigrade higher if the trial is made in a testing room. The author himself believes that the following temperature would be practicable: Ninety-five degrees centigrade for stationary windings, cotton insulated. For rotating coils, this temperature should be regarded as extreme and not allowable. Since it was found in practice that motors will stand with security temperatures from seventy-five to eighty degrees centigrade, it seems unreasonable to limit the temperature to fifty or fifty-five degrees centigrade. In speaking of the limit of fifty degrees centigrade, this means fifty degrees rise in the temperature of the motor itself above that of the room. The author also advocates rating motors by their torque and speed as well as power, and he submits a form which is thought to be suitable for this. This calls for a statement of the input of current in amperes, torque in kilogramme metres, revolutions per minute, and efficiency, all for one-half load, normal load, and fifty per cent overload.—*The Electrician* (London), August 8.

Notes on the Testing of Tramway Motors and Investigation of Their Characteristic Properties.

This paper, by Mr. M. B. Field, gives a very detailed study of suitable shop tests for tramway motors. The author first discusses the advisability of making shop tests, and states his belief that the usual method of equipping the car with the motors, and operating it over the road at various speeds and for specified lengths of time, is far from satisfactory. There is a tendency for manufacturers to rate their motors unequally. To avoid vagueness in this matter, he thinks it advisable that some satisfactory rating, such as that adopted by American firms, should be accepted. As a means of testing to see that the motors come up to these standards, the following arrangement has been found satisfactory: The motors to be tested are mounted in pairs, so that one operating as a motor drives the other through gearing as a generator. Since the motors under test are stationary and therefore not as fully ventilated as when mounted on a moving car, the door above the commutator is left open to compensate in some degree for the altered conditions. The current after passing through the motor field and armature passes through the field generator, ensuring the same magnetic conditions in the two machines. This is important, as it gives the same iron losses in each machine. This method of operating the motors is thought to be more accurate than Hopkinson's. The author then shows how the different losses of the two machines may be separated and the efficiency of each calculated. The method of constructing the characteristic curves is also described. A numerical example is taken and the results fully worked through and curves plotted. To determine the temperature rise the use of special thermometers is necessary, and a method of suitably mounting these on the machine is described. To obtain the temperature of the armature a thermometer with a bent bulb is used, inserted through a special opening in the motor frame. This is done in order to avoid any cooling of the motor which would result from opening the case to insert the thermometer. Before removing the motors from the testing frame he advises trying them for flashing in the following way: Run the motors up to a high speed, then short-circuit them after reversing the field. Under these circumstances they act as generators, generating current in the closed circuit. A comparison of different motors from this point of view is thought to be important. In carrying out this test an interesting phenomena may be observed, namely, if the test be applied to the motors when running at a high speed they stop quickly, and will then turn around in a reverse direction for a few revolutions. The explanation given for this is that, owing to the large self-induction and small resistance of the short-circuited motors, the current generated has not died away by the time the motors have been brought to a standstill. This current still circuits around the circuit as if supplied from an outside source and, field magnets being reversed, the direction of rotation is reversed. For obtaining the speed and torque curves the usual Prony brake method is suitable.—*Electrical Engineer* (London), August 15.

Calculation of a 50,000-Horse-Power, 80,000-Volt, 200-Mile Transmission Line.

After a preliminary discussion of the advantages of California in regard to

water power and fuel oil, the authors of this paper, Messrs. C. W. Hutton and R. Crowell, take up in detail the design of a high-tension transmission line of large capacity. Heretofore, western transmission plants for the utilization of water power have consisted of generating plants of small individual capacity as compared with some to be installed in the near future. The stability and close regulating qualities of such a plant would largely be influenced by the proper construction and working qualities of the transmission lines. A study of this problem is therefore interesting from an electrical standpoint. In the design considered, light steel towers are adopted in place of the wooden poles generally used for line supports. The cost involved in such construction is not considered, though an allowance is made for this by adopting a voltage somewhat higher than that given by Mr. C. F. Scott's rule. The line in the case assumed is 200 miles long. According to Scott's rule, the pressure in thousands of volts should be equal to one-third the number of miles to transmit. The voltage assumed is 80,000, being somewhat in excess of that called for by the rule. The power to be transmitted is 50,000 horse-power. Four cases are considered to determine which would give the best results: First, two three-wire, three-phase circuits operated at sixty cycles per second; second, the same lines as above, with a frequency of thirty cycles; third, four three-wire, three-phase circuits operated at sixty cycles; fourth, four three-wire, three-phase circuits operated at thirty cycles. Aluminum wire is adopted, the wires to be at points of equilateral triangles, spaced twelve feet between the centres. The power-factor of the delivered load is taken as eighty-five, and a preliminary figure of fifteen per cent for the loss of the delivered energy is assumed. The calculation for the first case shows that a 500,000-circular-mil cable would give a loss of 15.4 per cent. The inductance of one wire is found to be 0.393 henry, giving 148 ohms reactance at sixty cycles. The capacity of one wire is 3.05 microfarads, and the charging current per wire fifty-three amperes. The resistance per wire is 35.34 ohms. The current due to the delivered load of 25,000 horse-power is 158 amperes. The power component is 134 amperes, and the wattless component eighty-three amperes. The regulation in this case is found to be 34.2 per cent. For the same circuit operating at thirty cycles the regulation is found to be 23.2 per cent. It is in order to improve the regulation that the last two cases are considered. Here there are four circuits of 250,000 circular mils each. The inductance of one wire is 0.415 henry; its capacity, 2.89 microfarads. The charging current of one wire is fifty amperes; the resistance 70.7 ohms. The current due to the delivered load of 12,500 horse-power over one circuit is seventy-nine amperes per wire. The regulation of this line is found to be 18.2 per cent. For the same lines operated at thirty cycles, the regulation is found to be sixteen per cent. Further subdivision in the circuits would but slightly improve the regulation. It is evident from the foregoing that for a plant of this size, where the bulk of its capacity would be used for driving motors, a frequency of thirty cycles or less should be adopted, using motor-generating sets when lighting is required, thereby getting a much better voltage regulation for lighting than is shown in the average transmission system of to-day.—*Journal of Electricity, Power and Gas* (San Francisco), July.

The New and the Old Electrical Theories.

In the first two sections of this serial Mr. A. P. Trotter discusses, in a very interesting way, the old and the new electrical theories. Many of the recently observed facts of electrical science do not fit the old theory, and like many other old theories it must give place to another. Hidden away in the mathematical writings of a few men there are many plain and easily appreciated ideas of the new theory, and the object of these writings is not to give an original and popular account of the electrical theory, but simply to string together some of these ideas for those who have neither the time nor the inclination to study the original. The author then defines science, hypothesis and theory. The difference between knowledge and science lies, not in the quality nor accuracy of facts, but in their arrangement. The aim of science is to arrive at what are called laws. A scientific law is a brief statement of the relationship between a group of facts. These laws tell how the facts occur, not why they occur. A theory is a longer statement and often includes several laws. A theory in an early, imperfect stage is called an hypothesis. Neither the preliminary hypothesis nor the complete theory explains the facts, but a theory is sound and complete in so far as it is a satisfactory description of all the facts in the group, and not only those which we know to-day, but those which may be observed to-morrow. The important question upon which the old electrical theory must stand or fall is: Are electricity and electric currents necessary concepts? In the modern theory they are not necessary, and both are misleading. It is a matter of regret that the word "current" must remain, but it is too late now to change it. The word "electricity," on the other hand, can be thrown overboard at once. It is worse than useless. The author discusses the difficulties which Faraday and the mathematicians of that time had in understanding each other. Faraday, in his mind's eye, saw lines of force traversing all space where the mathematicians saw centres of force acting at a distance. Faraday saw a medium where they saw nothing but distance. Faraday sought the seat of the phenomena in real actions going on in the medium; they were satisfied that they had found it in the power of action at a distance. The one act of imagination by which Faraday conceived the space surrounding the magnet of a wire carrying an electric current to be full of lines of force gave him a concept upon which all his work of electrical dynamics is founded, and so vividly did Faraday picture these lines of force that he was able to make his great discovery of magnetic electric induction. Given that electricity was flowing through a wire, it provoked magnetism in a neighboring iron body. What was the converse? By sheer experimenting he arrived at the notion of cutting the lines of force in space by a wire. This cutting the invisible magnetic lines is the essential act necessary for induction and was entirely original with Faraday. He treated these lines of force as pure concepts. They were mere directions in which something called "force" acts. In discussing the use of the word "current" in our modern theory, the author quotes from Faraday: "The word 'current' is so expressive in common language that when applied to the consideration of electrical phenomena we can hardly divest it sufficiently of its meaning, or prevent our minds from being prejudiced by it." We can never rid ourselves of the unfortunate word "current," and it will always carry with it the suggestion that there is something which flows. The hard-worked hydraulic analogy supports that suggestion, and when an ampere is compared with the rate of flow of so many gallons per minute the student at once thinks that the element of time is comprised in the concept ampere.—*Electrical Review* (London), August 8 and 15.

INDUSTRIAL SECTION.

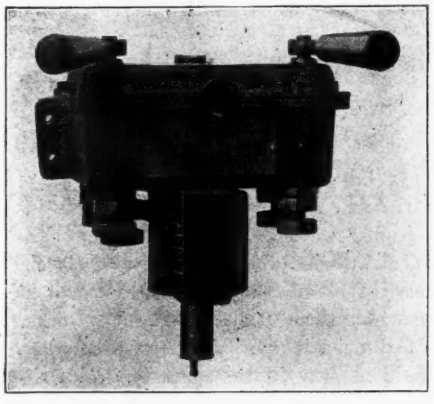
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Circuit-Breakers for Car Service.

The use of circuit-breakers as a means of protecting the car equipment from the effects of overload or short-circuit is speedily being recognized, and conservative managers are rewarding the efforts of designers of this class of apparatus by introducing wherever possible this valuable protective device. The advantages of such a device have long been recognized, but the peculiar conditions for street-car service were such that much time and experimenting were necessary to develop that which would be absolutely practicable in application.

The accompanying illustration shows a double-pole quadruple break oil circuit-breaker. This is compact and easily installed, and may be placed in damp and dirty locations without affecting its operations. For motor use, all the outside current-carrying parts are covered with insulating material. This circuit-breaker is made with laminated contacts for 750 volts or less with direct current, and for 1,100 volts or less alternating current. A valuable and practically new feature in the operation of this apparatus is the switching mechanism, working in an oil-enclosed tight metal case. In this manner, the arcing feature is almost entirely eliminated by surrounding the contact mechanism with a non-conducting fluid, this having a good effect in preventing the formation of an injurious arc under the most severe conditions of overload or short-circuit. The copper contacts, being surrounded by oil and enclosed in a metal case, are not subject to oxidizing influences of the atmosphere, and always present a bright, clean surface, which is necessary to ensure perfect contact. The contacts are of the laminated type, and both contacts and contact blocks are made of the best quality of hard-drawn copper. With the exception of the single-pole double-break type, these instruments are so constructed that it is impossible to close the circuit during the continuance of an overload or short-circuit. The handle arms controlling the switches operate independently, and it is necessary to close both sides before the circuit is completed. When an overload or short-circuit condition exists, the side of the switch which is closed will automatically fly open the instant it is attempted to complete the circuit by closing the second side of the switch.

This instrument is an oil-break switch as well as a circuit-breaker. A convenient tripping device is provided, which is operated by pressing a rubber knob located between the handles. Both sides of the switch instantly fly open, and as the break takes place in oil, there is no injurious arcing at the contacts. The action of the circuit-breaker is claimed to be thoroughly reliable in every way, and will positively operate when a current exceeds the amount for which it has been adjusted. The action of the plunger is positive, and if it moves at all, the blow



CIRCUIT-BREAKER FOR CAR SERVICE.

struck is such that under all conditions the switch will instantly open. The retaining catches or triggers are of case-hardened steel, and the friction in releasing is reduced by roller action.

This circuit-breaker is manufactured by the Hartman Circuit Breaker Company, of Mansfield, Ohio.

College Degrees for Correspondence School Students.

The American School of Correspondence has recently made an arrangement whereby the students are admitted to the classes of one of the great resident technical schools without further examination, and their work counts toward a degree of B. S. This shows in a most striking manner the wonderful advance in the standard of correspondence work in the past few years, and marks a new era in the educational possibilities of the common people. Ambitious young men who are too poor to give up four years to obtain a college degree can now do part of their work at home, and in this way finish with a few years at a resident technical school. In this connection the free scholarship withdrawal announcement of the American school in another column is of great interest, for it ends one of the greatest educational opportunities of the year. The trustees of the American School of Correspondence, Boston, Mass., have been offering a limited number of free scholarships to deserving young men for the purpose of securing a few representative students in the large shops. The school now announces that after September 30 no more free scholarships will be awarded. This is a good opportunity for a bright young man to get a course in mechanical, steam, textile and sanitary engineering (including heating, ventilation and plumbing) and mechanical drawing. Tuition to successful applicants will be entirely free, the only expense being (as in all schools) for postage and instruction papers.

Water-Wheel Governors.

The accompanying illustration shows the application of two differential-relay water-wheel governors harnessed to Leffel wheels. The plant is a rather interesting one, due to the special type of the governors. One of the governors, which governs the street railway load, is connected to the water-wheel, not by gears and shafting, as is ordinarily the case, but by a lever connection, thus eliminating all gears under water, and a great deal of friction and considerable loss also. The first governor was installed about four years ago, the second being installed a year later. The three water-wheels are of the vertical type, placed in a row and geared to a line shafting comprising three lengths and extending the entire length of the space occupied by the wheels. This shafting is provided with clutches so that the different lengths can be coupled together and operated as one solid piece of shafting.

The first length of shafting is operated by a forty-five-inch Leffel water-wheel, the speed of which is controlled by a governor belted to a 125-kilowatt Eddy street-car generator. As is usual in street-car service, the load is constantly varying

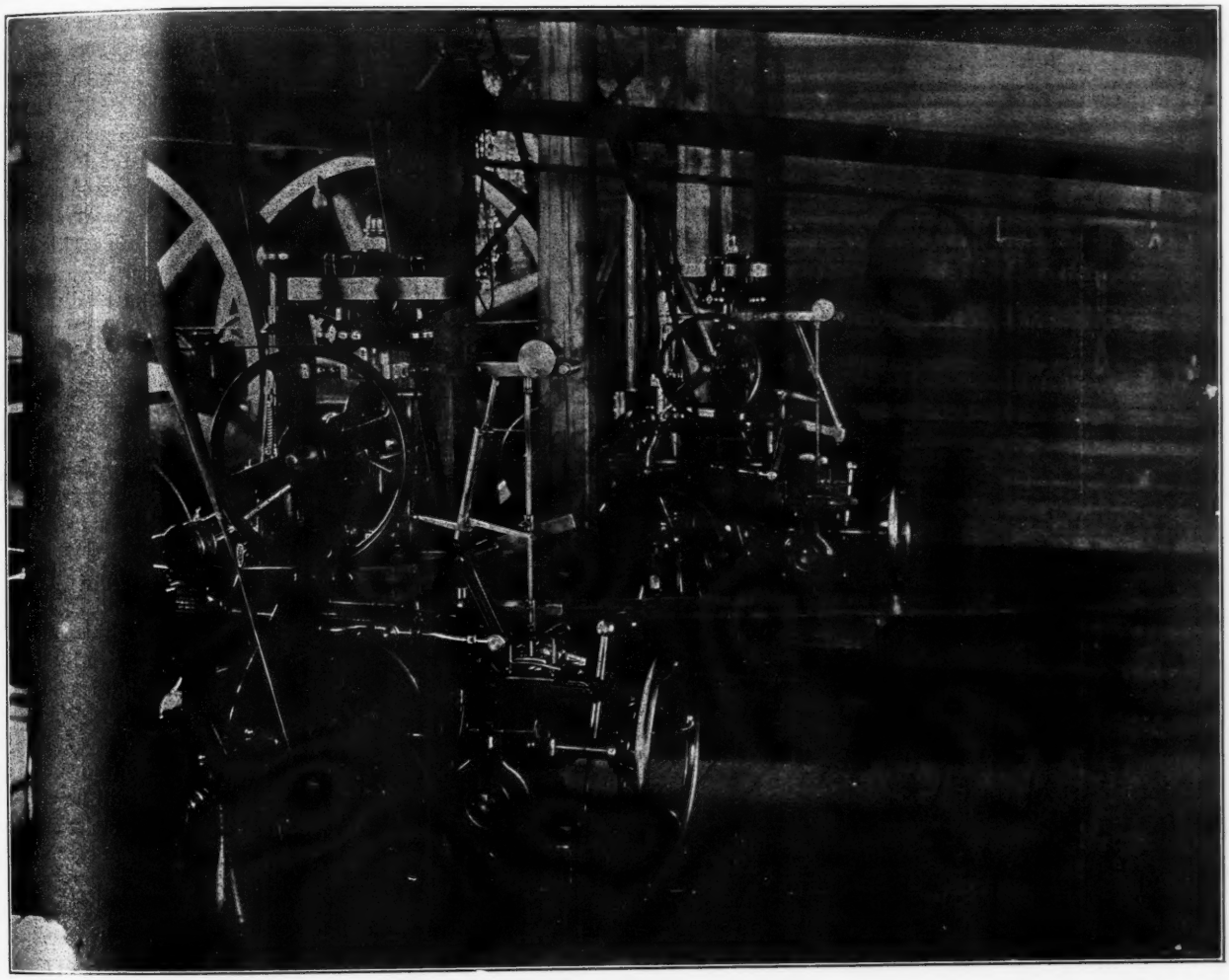
from no load to about an average. In the case of the present installation, it varies from half load for the machine to full load, and frequently there is considerable overload on days of heavy service. No matter how much the load may vary, however, the governor responds quickly to the demands made upon it, giving a regulation of seven per cent.

The second length of shafting is driven by a fifty-four-inch Leffel water-wheel. This wheel is used at times for driving the solid length of the three shafts. The speed of this machine is controlled by one of these governors, and this is belted to two (fifty-three kilowatts each) Westinghouse direct-current generators, and one 200-kilowatt alternator. The two Westinghouse machines run continuously night and day, and the load varies considerably, being heaviest during the early part of the evening. Just as soon as the dynamo demands more power the governor responds to the call and regulates the pressure for this large unit just as quickly and as well as for the smaller unit before mentioned.

In the evening the alternator is started early enough so that by the time the greatest demand is made there is plenty of pressure to satisfy all the customers' needs. The alternator is supplied with a clutch pulley at the line shaft, and is started with about seventy horse-power, the load, of course, growing heavier as the evening becomes darker, the governor bringing up the pressure perfectly in step with the demand. When taking off this machine in the morning by throwing out the clutch and letting it come to a stop the governor immediately goes to work, partially closing the gates until equilibrium is established. Should there be a sudden demand for more power at the machine during the day, such as a large motor being thrown into service somewhere, this governor instantly opens up the gates, allowing more water to go through the wheel until the new demand is amply met.

At dusk, when it is time to light the city's street arcs, the third wheel is started, and when up to speed the third line of shafting, which is driven by this wheel, is coupled in with the second length of shafting, the second governor then having the speed of both wheels to control by operating on the second wheel. This third length of shafting is belted to two Wood type arc machines of forty kilowatts capacity, and each has service for nine-tenths of its full capacity. These machines are cut in, one after the other, and the gate on the third wheel is opened by hand and then left to the governor to regulate. In the morning, when they are taken off, they are cut out one at a time, and at this instant a slight increase in the voltage of the incandescent lamps may be noticed, but only momentarily. The water is then shut off from the third wheel by hand gradually and the clutch slipped off. Of course, when the water is shut off from the third wheel the second wheel needs more water, so that it can perform the work which the third wheel has been helping on, and the governor in this case has never been found at fault in instant response to the peculiar demands in this plant.

The plant is operated by the A. Beyer & Lieser Electric Company, New Philadelphia, Ohio, and the governors were made by the Replogle Governor Works, of Akron, Ohio.



AN INSTALLATION OF TWO GOVERNORS REGULATING THREE WATER-WHEELS.

Association of Edison Illuminating Companies.

The twenty-third convention of the Association of Edison Illuminating Companies will be held at the Mount Washington, a hotel near Mount Pleasant House station, N. H., on the Boston & Maine Railroad, commencing Tuesday, September 29, 1902, at 9.30 A. M. A most successful convention from every point of view is anticipated, and each member company is assured of an interesting and entertaining session, and should not fail to send at least one delegate to this meeting. The following papers have been prepared:

"Recent Developments in Distribution System in Boston," by Mr. Sidney Hosmer, Boston.

"Aspects of Safety and Reliability in High-Tension Transmission and Distribution of Current from Annex Stations in Large Cities," by Mr. Philip Torchio, New York.

"Construction and Operation of Underground High-Tension Transmission," by Mr. H. J. Gille, St. Paul, Minn., and Mr. H. G. Carlton, Chicago.

"High-Tension Work in the Far West," by Mr. George H. Lukes, Chicago.

"Development of New Forms of Illumination and Their Possible Influence on Central Stations (Nernst Lamps, Hewitt Lamp and Welsbach Arc Lamp)," by Mr. George Eastman, Chicago.

"The Effect of the Nernst Lamp Upon Methods of Illumination," by Mr. Murray C. Beebe, Chemist Lamp Company, Pittsburg.

"The Distribution of Light from Incandescent Lamps as Affected by Shades Commonly in Use," by Mr. John W. Howell, engineer Edison Lamp Works, Harrison, N. J.

"Original Researches in Electrical and Chemical Laboratory," by Mr. Charles P. Steinmetz, General Electric Company, Schenectady, N. Y.

"The Order System and Its Influences Upon Cost," by Mr. William M. Anthony, Chicago.

"Campaigning for Business," by Mr. John F. Gilchrist, Chicago.

"Advertising and Canvassing," by Mr. Arthur Williams, New York.

"Commercial Conditions with Customers," by Mr. J. T. Maxwell, Philadelphia.

"Some Problems in the Design, Development and Operation of Large Central Station Systems," by Mr. P. Junkersfeld, Chicago.

"Utilization of Waste Energy of Central Stations," by Mr. W. H. Schott, Chicago.

"Steam Pipe Covering and Its Relations to Station Economy," by Mr. Henry G. Stott, superintendent motive power, Manhattan Railway, New York.

"Coal," by Mr. Robert Lindsey, Cleveland, and Mr. W. L. Abbott, Chicago.

"Storage Batteries," by Mr. Gerhard Gottling, Boston.

"Integrating Electric Meters and the Meter Department," by Mr. George Ross Green and Mr. P. H. Bartlett, Philadelphia.

"Checking Electrical Instruments," by Dr. C. H. Sharp, test officer, Lamp Testing Bureau, New York.

"Automatic Voltage Regulators," by Mr. W. S. Andrews, Schenectady.

"The Use of Superheated Steam," by Mr. Charles H. Parker, Boston.

Besides these papers there are other subjects prepared for presentation, the reports of various committees and the usual open discussion of the many papers and subjects presented.

The convention this year may occupy four days, with a morning and a night session each day, the afternoon being devoted to recreation. The programme of entertainment has not been finally decided upon. One feature of the entertainment will be a golf contest on the links at the Mount Washington, open for ladies and gentlemen.

A British Steam Railway to Be Operated by American Electrical Machinery.

The last of the main generators and engines intended to be installed in the power plant of the Mersey Tunnel Railway are about to be shipped from the Westinghouse works at East Pittsburg. These generators are of the railway type (1,200 kilowatts, 650 volts, 90 revolutions per minute) and are to be direct-connected to vertical cross-compound Westinghouse-Corliss engines of 1,500 horse-power each. The power-house lighting and the electric light of all stations, sidings, etc., will be supplied from a separate generating plant comprising two compound-wound generators, each having a capacity of 200 kilowatts at 650 volts, direct-connected to compound engines and running at a speed of 250 revolutions per minute. The power-generating plant will have an aggregate output of about 6,600 horse-power—6,000 horse-power for the railway proper and 600 horse-power for lighting. The Westinghouse electropneumatic system of train control is to be used and the cars will be equipped with Westinghouse high-speed air-brakes. The rolling stock will consist of sixty cars, each about sixty feet in length. The trains will be formed of five cars each, the first and last cars of a train being motor cars equipped with four 100-horse-power motors each.

The Mersey railway connects Liverpool and Birkenhead, and passes under the River Mersey. The tunnel is double-tracked. The route of the railway is about four and one-half miles long, the total length of track, including sidings, being about twelve miles long. Its situation is unique, joining two such important business cities between which the only competition in the transportation of passengers and freight is given by ferry-boats on the river, and the traffic on the line is large. The number of passengers carried amounted to between seven and eight millions per year even with the old steam locomotive system.

The railway is standard gauge, laid in accordance with heavy steam railway practice, the rails being of the ordinary English "Bull-head" type weighing eighty-six pounds per yard. The line is to be fitted with the third-rail system, the conductor rail to be laid alongside and just outside of the running track. The running rails will not be used as the return electrical conductor, but a fourth rail is to be placed between them solely for this purpose. This will entirely prevent any destruction of the track rails or buried pipes in the vicinity by electrolytic action. The third and fourth rails will be similar in size and in arrangement. They are to be of T-section, sixty feet in length and to weigh 100 pounds per yard. They will be effectively bonded and carried on stoneware insulators spaced at intervals of seven or eight feet apart.

It is expected that the trains will run on a three-minute service. The tunnel and the seven stations of the system are to be electrically lighted throughout. The power-generating station, the machinery and the trackwork are all being pushed rapidly to completion.

The international telephone lines between Como, Chiasso, Genoa, Turin and France have been opened to the public. Between Genoa and Turin the fee for service is one lira (twenty cents). Between Genoa and France the rates are 3, 3.50 and 4.50 lire according to the distance. The work of the Rome, Turin, Milan line had to be stopped owing to the lack of bronze wire, which is being manufactured at Bergen, Norway.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

NEW MARCONI STATIONS—Orders have been issued to have an expedition start for Anticosti and Labrador, where stations will be built to operate the Marconi wireless system of telegraphy. Mr. Francois Brenton, clerk of the works of the department of public works, will superintend the work.

ELECTRIC POWER IN PENNSYLVANIA—The Pennsylvania Railroad Company is to install electric motive power between Pittsburg and Pitcairn. A motor is now under construction which has been designed in accordance with plans prepared by the Pennsylvania Railroad Company's engineers. The third-rail system is to be employed, and is similar in character to that recently adopted by the New York Central Railroad management.

EDISON BATTERY TEST—It is announced that the first test of the new Edison battery in a specially built car will be made in the 500-mile endurance contest to be held by the Automobile Club of America early in October, the test being a run from New York to Boston and return. The claim is made that the new battery will propel a vehicle farther than any of the other batteries now in use, and it has been predicted that the Edison battery will propel a vehicle eighty miles without being recharged.

WIRELESS TELEGRAM RATES—The Cunard Company, in its information to passengers, includes the following interesting item: From wireless telegram from ship to Marconi station, sixpence per word; from ship to passing steamer, and thence to station, sixpence per word. The maximum rate *via* Sagaponack is $2 for ten words, in addition to the land charges and fifty cents per message for cost of delivery to Western Union office at Bridgehampton. The minimum charge *via* Crookhaven or stations in the United Kingdom is six shillings and sixpence.

NEW COPPER COMBINE—There has been perfected in Buffalo a combination of the richest copper interests in the world, according to recent despatches. There are seven companies involved, with a total capital of $97,600,000. The company excludes the Amalgamated, Anaconda, Calumet, Hecla and Clark interests, and has exclusive use of the Garrettson smelter, being able to land copper in New York, it is claimed, at two cents a pound and make money. The principal concern in the deal is the Copper River Mining Company, which has, it is alleged, 3,000,000 tons of sixty, seventy and eighty per cent ore in sight—more than can be mined in twenty years.

THE GERMAN AGRICULTURAL DEMAND FOR ELECTRICITY—A recent report from Consul General Hughes at Coburg as to the use of electric power in the agricultural districts in Hanover, quotes an authority as expressing disappointment at the comparatively small return for the large installation necessary. The greatest demand for current is for the operation of threshing machinery, although energy was also used for driving pumps, hay presses, straw cutters, etc. Of the total horse-power installed, seventy-seven per cent represented purely agricultural operations and eight per cent factories, although the former yielded fifty-three per cent of the receipts. On an average, the annual revenue per horse-power installed amounted to $6.73, as compared with $17.03 to $36.50 in towns, at a price of fifty-seven cents per kilowatt-hour. The average period of use did not exceed 150 hours for the country towns and for the villages, as against 500 hours in the towns.

TWO NEW ELECTRICAL PROJECTS IN INDIA—The Burmah Tramway Construction Company, Limited, has been registered in London with a capital of $250,000, to construct, equip and work as owners, lessees or contractors, railways, tramways, undertakings for the generation, supply or distribution of electric and other power, either for the purposes of locomotion, for the working of plants or machinery, or for telegraphic or telephonic purposes, or otherwise. The East India Tramways Company, Limited, has been registered with a capital of $400,000, for the purpose of constructing and working tramways, railways and property in India, to equip, work and maintain by electricity or other power any of the East India Tramways Company's property now in liquidation. It is also contemplated that the new project will carry on a general business of manufacturers of and dealers in locomotives, rolling stock, accumulators, dynamos and accessories, and suppliers of electricity for light, heat and power.

TO PROMOTE COMMERCE WITH CHINA—A new company entitled the Chinese-American Commercial Company has been incorporated in San Francisco. The incorporators number among them the leading business men of the Pacific coast, and the capital stock has been fixed at $1,000,000 gold, of which $135,000 has been subscribed. The professed purpose of the Chinese-American Commercial Company is to develop business and trade between the two nations. The company will establish commercial museums for the exhibition of American manufactures and products all over China, and will do the same in the United States for China's products. The principal offices of the company will be in San Francisco, Chicago and New York. The San Francisco business will be directly under the management of Mr. George T. Hawley, of the Hawley Brothers Hardware Company, under the supervision of the board of directors. The principal Chinese offices will be in Hong Kong, the gateway to the south, and at Shanghai, the gateway to the north of China.

ELECTRIC RAILWAYS

GENEVA, N. Y.—The Rochester & Eastern Rapid Railway Company has been granted a franchise to use certain streets of the town of Geneva.

DUNCANNON, PA.—A new trolley line, to be known as the Perry County Electric Railway, has been chartered to connect Duncannon, Marysville and intermediate points.

BILOXI, MISS.—The city council has granted a franchise to E. E. Joullian to use the streets of the town for an electric railway and lighting system. It is understood that work will be commenced at an early date.

PORTSMOUTH, VA.—The Old Dominion Street Railway Company has passed into the control of the Norfolk, Portsmouth & Newport News Company. It is said that hereafter the cars on both lines will be operated under one management.

ELKTON, MD.—The Cecil & Kent Trolley Company has been granted a franchise for the use of the streets of this city. The company will soon commence work in building lines to connect with Newark, Del., and Chesapeake City, thus making a through line from Wilmington to Chesapeake City.

MOLINE, ILL.—The Kewanee, Cambridge & Geneseo Railway Company has been incorporated with a capital of $100,000, and headquarters at Kewanee. The plan is to build a street car line connecting the places named. The incorporators are: G. A. Anthony, Theodore Boltenberg and Robert W. Olmsted.

ONEIDA, N. Y.—A certificate authorizing the extension of the Oneida Railway Company's lines from the city of Oneida to the town of Sullivan, Madison County, passing through the town of Lenox and the village of Canastota—a distance of eight miles—has been filed with the Secretary of State at Albany.

TERRE HAUTE, IND.—The Paris & Terre Haute Traction Company expects to begin work within sixty days on its line from Paris to Terre Haute. The ultimate object of the company is to build a trunk line from Indianapolis to Springfield, by way of Paris, Terre Haute, Charleston, Matoon and Decatur.

KANSAS CITY, MO.—A franchise for twenty-five years has been granted by the County Court to the Kansas City, Forest Hill & Swope Park Electric Railroad Company for an electric line to Swope Park. By the terms of the franchise the road must be in operation by June 1, 1904, but it is expected that it will be built by June, 1903.

LOUISVILLE, KY.—Work has commenced on the Jeffersonville, New Albany & Sellersburg Rapid Transit Line. The road will be ten miles in length and will cost in the neighborhood of $250,000. The Tennis Construction Company will build the line, and expects to have the work completed by the middle of January. The lighting plant will supply the power for the road.

CINCINNATI, OHIO—An electric road known as the Cincinnati, Milford & Loveland Electric Railway is to be built be-

tween Cincinnati and Loveland by Cincinnati capitalists, and work has already commenced. As yet no company has been formed, but the money necessary to construct and equip the road has been provided. It is expected that the road will be completed and in full operation by July 1 next.

INDIANAPOLIS, IND.—The Newcastle, Muncie & Alexandria Traction Company has been incorporated with a capital of $10,000. The purpose of the company is to construct electric street and interurban railways in and between the towns of Newcastle, Mt. Summit, Springport, Oakville, Cowans, Muncie, Alexandria and Normal City. The directors for the first year are: E. T. Ice, Clay C. Hunt, J. T. Thompson, F. P. Ice and John H. Davidson.

DENVER, COL.—A new ordinance authorizing extensions of the Denver City Tramway Company's lines in all parts of the city is now being prepared and will be introduced in the board of supervisors as soon as certain details have been worked out. The new ordinance will provide for compensation to the city for the use of the streets and will contain a time limit within which all the rights granted must be utilized by the construction of lines, or they will lapse.

ELKTON, MD.—The Baltimore & Chestertown Railroad, of Kent County, has been incorporated with the following incorporators: Henry R. Fothergill, of Wilmington; Harcourt N. Trimble, of Philadelphia, and Hope H. Barroll, Wilbur W. Hubbard, William B. Copper, T. Benjamin Durding, Elmer E. Leary and Thomas R. Hubbard, of Kent County. The object of the road is to build an electric line from Chestertown to Rock Hall and to Tolchester Beach. The capital stock of the company is $75,000.

NORTH YAKIMA, WASH.—Surveys are about complete for a general system of electric railways to reach every important point in the Yakima Valley. The road is to be known as the Yakima Valley Central. It will extend for ninety-nine miles from this city, and includes lines to Sunnyside, Moxee, Parker, Zillah, Ahtanum, Cowiche, and the Natchez valleys. The estimated cost of the line is $700,000 It is understood that a firm in New York city is furnishing the money, and that the road will be in operation within a year.

ANN ARBOR, MICH.—It is stated that it is proposed to combine the following electric lines: The Detroit, Ypsilanti, Ann Arbor & Jackson, the Grand Rapids, Grand Haven & Muskegon; the extension of the Detroit, Ypsilanti, Ann Arbor & Jackson from Jackson to Lansing, and the lines of the Railways Company General from Battle Creek to Kalamazoo, with a link between Jackson and Battle Creek and the Grand Rapids city lines. The alleged plan of the new combine is to form a parent company, with a capitalization of $15,000,000 or $20,000,000.

ANNAPOLIS, MD.—A mortgage has been placed on record in the Circuit Court for Anne Arundel County, from the Washington, Baltimore & Annapolis Electric Railway to the Federal Trust Company, of Cleveland, Ohio, to secure an issue of bonds to the amount of $2,000,000. It is understood that the completion of the electric line now being built by this company from Washington to Baltimore will be expedited as much as possible. The company has bought two acres of ground in East Hyattsville, and will erect an immense power-house at a cost of about $350,000.

MUNCIE, IND.—The Muncie & Portland Traction Company has been organized with a capital of $100,000. The company will build an electric line from Muncie to Portland, a distance of twenty-eight miles, through the towns of Albany, Redkey and Dunkirk. The directors of the company are Judson A. Jaqua, Truman O. Boyd and John Dettamore, of Portland, and G. O. Driscoll and Harve Leffler, of Muncie. The officers are: President, G. O. Driscoll, of Muncie; vice-president, Harvey Boyd, of Portland; treasurer, Nathan B. Hawkins, of Portland. Construction has already begun.

OMAHA, NEB.—Formal announcement has been made that arrangements have been completed for the absorption of the Omaha & Council Bluffs Railway & Bridge Company by the Omaha Street Railway Company. The transfer will include the Missouri River bridge, the Council Bluffs lines, the Lake Manawa lines, the property and franchises of the Suburban Railway Company, and the other property owned and controlled by the Council Bluffs Company. The company states that it proposes to build a new power-house, to cost at least $500,000, and that altogether the expenditures will amount to more than $1,000,000.

AUGUSTA, ME.—The Maine & New Hampshire Railroad Company has been incorporated for the purpose of building a trolley line which is to be ninety miles in length. The road will extend from Hiram, in Oxford County, through the towns of Baldwin, Standish, Cornish, Limington and Dayton to Biddeford. A branch will extend through Limerick, Waterboro, Newfield, Shapleigh and Acton. Another branch will extend from Cornish through Parsonfield to the state line; still another will extend from Limington through Standish and Gorham, and connect with the Westbrook, Windham & Naples Railway at Windham. The capitalization of the company is $400,000. The directors are George B. James, of Boston; A. Crosby Kennett, of Conway, N. H.; E. E. Hastings and Henry Andrews, of Fryeburg, Me., and Leslie C. Cornish, of Augusta, Me.

OBITUARY NOTICE

MR. E. P. WHITFORD, one of the oldest telegraph operators in this country, died at one o'clock August 28, in the Onwentsia Club House, Lake Forest, Ill., of heart failure. He had charge of the Postal Telegraph Company's corps of operators on duty at the Western Women's Championship. Complaining early in the day of ill health, he was taken with a sinking spell shortly after twelve o'clock, and although professional help was immediately secured, restoratives were administered to no avail. Mr. Whitford was very well known to thousands of operators throughout the country. For some years he had charge of the Board of Trade office in Chicago.

PERSONAL MENTION

MR. FRANCIS M. GILLEY, of Boston, the author of several technical books, is spending the summer in Zurich.

MR. E. J. HALL, general manager of the American Telephone and Telegraph Company, returns to New York this week from a short vacation in Europe.

MR. C. J. GLIDDEN, former president of the Erie Telephone Company, is spending the summer in a touring automobile in Europe. Mrs. Glidden and two friends and an expert chauffeur accompany him.

MR. C. E. PAGE, for many years Cincinnati manager of the Western Union Telegraph Company, has succeeded Thomas Roche as superintendent of the eastern district of the same company.

MR. J. B. ROHRER, chief engineer of the Honolulu Rapid Transit and Land Company, has resigned from that position, and is now traveling with the expectation of shortly arriving in the United States. Mr. Rohrer will probably make his home in Lancaster, Pa.

MR. J. W. AYDON, Wilmington, Del., was a New York visitor last week. Mr. Aydon, who is the superintendent of fire and police telegraph of his city, is a prominent official of the Municipal Electricians, which organization meets in Richmond, Va., the second week in October.

M. ROCHEFORT, inventor of one of the systems of wireless telegraphy now being tested by the United States Navy Department, recently arrived at Washington from France, bringing some additional apparatus which is to be submitted for testing purposes.

MR. J. L. PUTNAM, manager of the Clark Automatic Telephone Switchboard Company, Providence, R. I., has returned from a trip through the southern and central western states, meeting with success in establishing companies for several small towns, and others are in view for early operation.

MR. BELVIDERE BROOKS, general superintendent of the eastern division of the Western Union Telegraph Company, has been appointed general superintendent of the southern division of the same company, in place of Mr. James Merrinew, whose resignation took effect September 1. This appointment places Mr. Brooks in charge of both divisions.

MR. CHARLES T. YERKES, the former Chicago street railroad man, who is now equipping London with a new underground railroad system, operated by electricity, arrived on the steamship Majestic last week. Mr. Yerkes stated that the London underground is now carrying 200,000,000 persons per year. The new roads will increase that amount from fifty to one hundred per cent, and they will be in operation within eighteen months. The company now has three stations to the mile, operates 1,000 cars and uses the third-rail system.

ELECTRICAL SECURITIES

The week ended with a market that showed somewhat less activity than ordinarily. This was due largely to uneasiness as to the money situation. The money market was the chief centre of interest in Wall street during the short business week, and the exchanges generally closed down from Saturday until the following Tuesday morning. For the earlier part of the week, money was fairly easy, with the bulk of the loans made around 3½ and 4 per cent. On the last day there was a slight tightening of the market, with the closing much easier.

News from the coal regions this week has not been reassuring. The operators have taken occasion to announce emphatically during the week that they will permit no interference from outsiders and are still firm in their position not to give way to the demands of the strikers. Collieries are being opened gradually, and shipments in a small way have been reported to have been made.

ELECTRICAL SECURITIES FOR WEEK ENDING AUGUST 29.

New York:	Closing.
Brooklyn R. T.	67¾
Con. Gas	224
Gen. Elec.	196
Kings Co. Elec.	202
Man. El.	135½
Met. St. Ry.	148
N. Y. & N. J. Tel. Co.	175
Westinghouse Mfg. Co.	228
Am. Union Electric Co.	13¾

The Coney Island & Brooklyn Railroad's quarterly report, filed with the railroad commissioner during the week, shows a surplus for the quarter ending June 30 of $191,811, an increase over the corresponding period in 1901 of $70,819. In the last quarterly report of this company, a deficit appeared of $145. Operating expenses for this quarter are $15,396 greater than for the quarter ending March 31. The increase in gross earnings for the present quarter was $23,211, as compared with an increase for the last preceding quarter of $14,516.

Boston:	Closing.
Am. Telep. & Tel.	172½
Edison Elec.	280
Mass. Elec. pf.	97
New England Tel.	141
Western Telephone & Telegraph.	101

The Western Telephone and Telegraph Company has this month declared its first dividend on its preferred stock. The dividend amounted to 2 per cent, and was at the rate of 4 per cent for the year. In less than a year and a half, this stock becomes cumulative 6 per cent stock.

Philadelphia:	Closing.
Elec. Co. of America	9⅛
Elec. Stor. Bat. c.	90
Elec. Stor. Bat. pf.	89
Philadelphia Elec.	7½
Union Traction	48
United G. I. Co.	113½

Chicago:	Closing.
Chicago Edison Light	173
Chicago Telep.	174
Metropolitan El. pf.	89
National Carbon	31¼
National Carbon pf.	100
Union Traction	16
Union Traction pf.	48

The directors of the Chicago Telephone Company have declared the regular quarterly dividend of 2½ per cent, payable October 1 to stockholders of record at the closing of the books September 20. The company has gained 2,000 subscribers during the last month.

ELECTRIC LIGHTING

MARSEILLES, ILL.—The Pioneer Electric Lighting, Heating and Power Company. $25,000. Incorporators: J. E. Bond, J. A. Kelso and R. E. Knott.

NEW ORLEANS, LA.—The council has passed the ordinance accepting the bid of Herbert A. Bullard, of Cincinnati, for the erection of an electric lighting plant on the immediate ownership plan, to cost $1,369,000.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company will expend about $100,000 improving its buildings and plant. The work will commence at once, and it is proposed to have it completed by October 1.

CHARLES CITY, IOWA—The Charles City Electric Light and Heating Company has been granted a twenty-five-year franchise, and will at once begin work on the erection of a large power plant which will be ready by the holidays.

ASTORIA, N. Y.—The New York & Queens Electric Light and Power Company has completed improvements to its large power-house on the East River front. Stations have been established at Jamaica and Flushing. The improvements have cost more than $500,000.

COLUMBUS, OHIO—The city lighting plant will be erected under the mandamus order of Judge Badger last fall, and with funds available under an ordinance passed four years ago authorizing a bond issue of $175,000. There is still $110,000 of that issue which can be made available.

THOMPSONVILLE, CT.—The Hartford Carpet Company is to substitute electricity for steam in its mills. Work has begun on a power-house which will contain twenty-four boilers and four engines of 1,000 horse-power each. The power-house will be one of the largest in the United States.

MEMPHIS, TENN.—Application has been made in the register's office for a charter for a company to be known as the Citizens' Gas and Electric Company, with a capital stock of $100,000. The incorporators of the new company are: J. H. Stolper, Percy H. Patton, Louis E. Defant, Henry Craft and August H. Buch.

RICHMOND, S. I.—The newly organized Richmond Light, Power and Railroad Company will assume charge of the Staten Island Electric Railroad and New York & Staten Island Railroad companies on September 1. It is understood that the officials of the two companies will be the same as are now in charge.

COHOES, N. Y.—The Hudson Valley Railway Company will build a large dam across the Hudson River at a point north of Warrensburgh. The dam and power-house will be constructed to supply a minimum of 2,000 and a maximum of 4,500 horse-power. A pole line will be constructed and telephone wires strung at once. The power-house will be built next spring.

SAN FRANCISCO, CAL.—It is reported that the Standard Electric Company, which has just completed a power system extending from Tuolumne County, where the power is generated to this city, *via* San Jose, is negotiating for the purchase of the Central Light and Power Company, capitalized at $700,000; the Equitable Gas Company, capitalized at $5,000,000, and the Mutual Electric Company, capitalized at $500,000.

SCHENECTADY, N. Y.—The Empire State Power Company has awarded to Henry W. Grieme and B. E. Machold, of Amsterdam, the contract to make extensive repairs to the power plant at Schoharie Falls, involving an expenditure of $60,000. The present dam is to be extended 210 feet, and a dike more than 700 feet will be constructed. The company will be enabled to supply approximately 4,000 horse-power.

FORT WAYNE, IND.—The newly organized Fort Wayne Electric Light and Power Company has made application for a new forty-year franchise for commercial lighting. The company offers to reduce the light bill for the city $15 per lamp per year, and to pay the city $120,000 for the franchise in forty annual installments. In case this cash proposition is accepted, the company wants the pole tax and all other special taxes remitted.

BEVERLY, MASS.—The Houghton County Electric Light Company has been incorporated with $1,300,000 capital. Lawrence A. Ford, of Beverly, Mass., is the majority stockholder, and the directorate is made up of men interested in the Houghton County Street Railway Company and the Peninsula Electric Light and Power Company, which will be taken over by the new organization. The general offices are in Boston.

SAN FRANCISCO, CAL.—A contract has been let by the McCloud River Electrical Power Company to the San Francisco Construction Company and George W. Elder to construct a concrete and masonry dam on the McCloud River, about twenty miles from Baird station, Shasta County. This will be one of the largest power dams in the state of California. The dam is to be about 100 feet high and about 500 feet long, and will be constructed of concrete masonry and rock filling. With the fall of water obtained, about 27,000 horse-power can be furnished. The cost will be in the neighborhood of $500,000.

INDUSTRIAL ITEMS

Ross & Company, of 95 and 97 Liberty street, New York, have installed a large number of their mechanical stokers in the stations of the Boston Elevated Railway. The Charleston and Harvard Square stations of this company have exclusive installations of these stokers, and there are several in the Lincoln station.

The Economical Electric Lamp Company, 123 Liberty street, New York city, is meeting with a gratifying demand for its turn-down lamp. One style of this lamp is so constructed that no matter what the position of the lamp might be or its height, it may be turned from very bright to dim, and subsequently turned out completely by the manipulation of a pendent cord. Full information will be sent to any who are interested upon request.

The Kinsman Electric Railway and Supply Company, 91 Liberty street, New York, is equipped to handle manufacturers' goods of every description in the line the business name signifies. The trade-mark of this company is a cauldron boiling over a hot fire and suspended over a jet is a dancing ball. The company will send specifications for tools and equipments for street railroads and makes a specialty of filling orders for new work and renewals for contracts engineers of electric light companies.

Thomas Porter, Sons & Company, Philadelphia, Pa., manufacturers of oilcloth and linoleum, have adopted electrical power distribution for the operation of their oilcloth and linoleum printing machines, elevators, the blowers used for drying oilcloths, and other general work about the plant. The Westinghouse Electric and Manufacturing Company has recently secured the contract for six induction motors which will be added to the present equipment of one 160-kilowatt and one 120-kilowatt two-phase 220-volt alternators, and fifteen or twenty induction motors.

The Lunkenheimer Company, Cincinnati, Ohio, manufacturer of brass and iron valves, injectors, lubricators, oils and grease cups and steam specialties, has issued a special revised edition of its catalogue, which cancels all previous issues. The book contains 210 pages, and the devices manufactured by this company are carefully illustrated and described. In addition to the general descriptive matter, there has been added considerable information of a valuable engineering nature, and the whole volume is carefully indexed. This will be sent to those interested on application to the company.

The Hayden & Derby Manufacturing Company, New York city, is distributing its latest catalogue illustrating goods manufactured for stationary plants and marine and portable boilers. The articles illustrated and described are the Metropolitan automatic injector, the Metropolitan 1898 injector, and the Metropolitan double-tube injector. The Hayden & Derby ejectors, used in various forms, and other jet apparatus are also illustrated. There has been embodied in this catalogue a great deal of useful information relating to this apparatus, showing the results that can be attained under various conditions found in practice. This will be found of value to any one about to install or operate goods of this character. The company will be pleased to forward a copy of this catalogue to any one interested.

The Western Electrical Supply Company, St. Louis, Mo., has been unusually successful with the Browning small motors and generators, for which it is the general sales agent. This type is made in sizes from one-fortieth of a horse-power to ten horse-power, and one-eighth kilowatt to eight and one-half kilowatts, and has met with instantaneous success. The company claims that the material and workmanship of this machine are the very best, and that they are sold under the strongest guarantee. The apparatus being especially designed to be used where a high-grade, strong and compact motor is necessary, is adapted for all small power works, manufacturers, jewelers, hotels, clubs, restaurants, etc., or small lighting plants. A very complete bulletin, covering this apparatus, will be mailed upon application.

The Electric Storage Battery Company, Philadelphia, Pa., in order to anticipate the convenience of its customers, has opened a number of Exide battery depots in different localities for the purpose of maintaining the Exide accumulator batteries in the best possible manner, and securing to the owners the same care and supervision of equipment that they would receive at the company's main factory. These depots are fully equipped, and are placed under the charge of experienced battery men competent to advise in all matters pertaining to the operation of Exide batteries and to generally supervise the treatment received in the way of charging, etc. These depots have been located in New York, at 148 West Eighteenth street; Philadelphia, 250 North Broad street; Buffalo, 200 Pearl street; Chicago, 264 Michigan Boulevard; St. Louis, 3937 Oliver street; Detroit, 101 Woodward avenue.

Mr. Joseph E. Lockwood, president of the Michigan Electric Company, Detroit, writes that the Michigan Lake Superior Power Company, at Sault Ste. Marie, has contracted with the Stanley Electric Manufacturing Company, at Pittsfield, Mass., for a large portion of its electrical machinery. Eighty groups of turbines are to be used, each group consisting of four 125-horse-power turbines mounted in two pairs on one shaft, thus furnishing 500-horse-power turbine capacity for each shaft, half of these being already in place; and to each of these shafts is to be connected a 400-kilowatt generator. Twenty-three of these eighty groups of wheels, or a total of 11,500 horse-power, have been leased to the Union Carbide Company, the Westinghouse generators for which are now being delivered and set up. The balance of the electrical equipment will be Stanley machinery, part of which has already been shipped, and additional machines are now in course of construction at Pittsfield, Mass. The switchboard is to be of a special and particularly up to date and improved character, probably more so than anything now in use, the Stanley company having developed the switchboard and controlling appliances and now have them in course of completion.

The Allis-Chalmers Company, Chicago, Ill., has secured orders for a number of Sederholm boilers, for the Broad street station in Philadelphia, of the Pennsylvania Railroad, as well as for its Juniata shops. This was after a most searching investigation, and after the railroad having had practical experience of its own with pretty nearly every boiler manufactured. These boilers have now been in successful use for several years and distinguished themselves especially through their perfect circulation and complete combustion, as well as through their great accessibility, which permits of a most thorough cleaning, without the time absorbing process of taking off hundreds of hand-hold plates. They are in very general use on the sugar plantations in the Hawaiian Islands, where the Allis-Chalmers Company has furnished a great number of large high-lift pumping plants for irrigation purposes. In the islands the coal used is mostly Australian or Puget Sound coal, both kinds of which are difficult to burn without smoke, but wherever these boilers are installed the plants show a smokeless chimney.

The Sprague Electric Company, New York city, is achieving great success in securing many important contracts for its motors and generators, and both its Watsessing factory and New York conduit factory are rushed to the utmost. In addition to its foreign orders and many orders for small size apparatus, it has recently made the following sales: Atlas Portland Cement Company, Hannibal, Mo., seven 35-horse-power motors and eight 15-horse-power motors; Atlas Portland Cement Company, Northampton, Pa., one 30-horse-power motor and two 35-horse-power motors; E. W. Bliss, New York city, fifteen 10-horse-power motors, seventeen 25-horse-power motors and one 50-horse-power motor; Lehigh Portland Cement Company, Wellston, Ohio, one 300-kilowatt belted generator, one 250-horse-power motor and six smaller motors aggregating 100 horse-power; Government Printing Office, Washington, D. C., contract for ventilating plant consisting of direct-connected American blowers and the following motors, one 5-horse-power motor and one 10-horse-power motor, two 15-horse-power motors and eight 20-horse-power motors; American Can Company, New York city, one 75-kilowatt engine-type generator and one 35-kilowatt belted generator; Lewis Institute, Chicago, one 75-kilowatt, split-pole, engine-type generator; George A. Fuller Company, New York, for the ventilating system in R. H. Macy's new store, four 25-horse-power motors and one 10-horse-power motor; Miller, Tompkins & Company, New York city, one 15-horse-power motor; Hibbard-Rodman-Ely Safe Company, Plainfield, N. J., two 25-horse-power motors; Goes Lithograph Company, Chicago, twenty motors, various sizes; Charles Schweinler, New York, fifteen 5-horse-power motors; Tucker Electrical Construction Company, for the National Meter Company, Brooklyn, N. Y., one 75-kilowatt, split-pole, engine-type generator.